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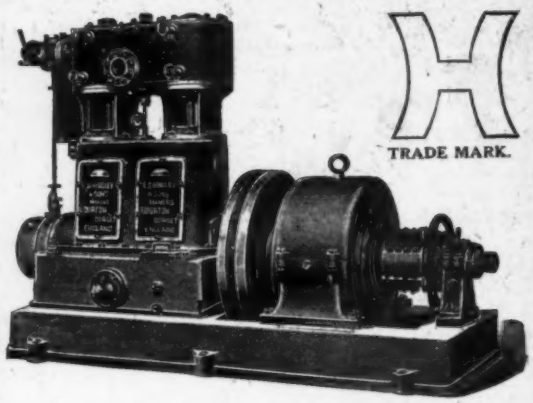

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A UNITED STATES SUPERPOWER SCHEME.

ELSEWHERE in this issue we give an abstract of the progress report of the "Superpower Survey" which is acting under the Geological Survey of the United States in investigating the Boston-Washington industrial region; as we recently explained, the object of this inquiry is to secure "a larger supply of cheaper power"—precisely that which was outlined by our Coal Conservation Committee, from which has sprung the Act of 1919. The data so far obtained, and the proposals of the Survey, present features of great interest.

As in our own case, enormous economies are foreshadowed from the operation of the scheme of centralised generation and interlinking of generating stations throughout the area under consideration, which is comparable in size with Great Britain, and much larger than England and Wales. The electrification of railways in the area to the extent of one-third of the mileage is expected to make an annual saving of six million tons of fuel, and to yield a return of 14 per cent. on the capital cost. At least as much coal would be saved by the increased industrial use of electricity, and nearly as much more of anthracite by electrifying the mines. The existing central stations consume on the average $2\frac{3}{4}$ lb. of coal per kWh; it is estimated that this could be reduced to $1\frac{3}{4}$ lb., effecting a saving of four million tons of coal. The total power requirements in 1930 are expected to amount to 48,000,000,000 kWh a year, of which three-quarters will come from the "superpower system," but even in the United States only a quarter of this can be got from water power, so that economy of coal is a fundamental consideration. The legislative Acts which will be required are outlined in our abstract, from which it will be seen that "new capital is the keystone of the project, but the public demand is its foundation." The idea is to form a superpower company supported by the existing supply authorities in the first instance, and by public subscription for the remainder. Arrangements are contemplated which will ensure that the consumer shall benefit by the increased efficiency resulting from the operation of the scheme, while the company will have freedom of action, and a liberal rate of remuneration, any excess above a specified rate being shared with the customers. State regulation of charges will continue without modification.

It will be seen that the plan goes further than anything that we have contemplated in this country. It does not mention Electricity Commissioners or Joint Electricity Authorities—it goes straight to the root of the problem, places dependence "on the incentive of private initiative to lower costs," and provides for the incorporation of a single company to work this vast area as one undertaking! It confidently fixes a pressure of 250,000 volts for the transmission of energy over distances exceeding 200 miles, and half that pressure within the area. Here, on the other hand, we are cautiously splitting up the country into thirteen or more areas which, in comparison with the Atlantic Seaboard scheme, are mere parishes, and we are hoping to place these areas under the control of as many separate communes, plus the Electricity Commissioners—but, so far, our hopes have not shown much prospect of realisation, for even the first authority has still to be born, and we are beginning to fear that after all the travail it may prove to be still-born. *Are we on the right track?*

Some additional light was thrown on the American

proposals by the chairman of the Superpower Survey in an article published by the *Electrical World* on January 1st, 1921. Adopting the form of question and answer, he there stated that the new stations might be of the order of 300,000 kW each; a station which is now being built in New York City is expected to produce the kilowatt-hour for 17,000 B.th.u., and that will be suitable for inclusion in the scheme, but stations of lower efficiency will be used only on peak load, when the efficiency is of less consequence than the capital cost per kilowatt. In brief, the functions of the superpower system are twofold: By forming "a great economic pool of power," to effect (*a*) the reduction of the cost of a kilowatt; (*b*) the reduction of the cost of a kilowatt-hour. This is a concise and telling form in which to cast the problem which we also have before us. The network may consist of a "ring bus" connecting the various centres of generation, and working at 110,000 volts, but it is not expected that one generating station will supply power to another; they will supplement one another, and the sub-stations will form the clearing-house for that purpose. A central control system under the charge of a load dispatcher will be necessary. The Survey has received the most hearty co-operation from the public utilities, railways, and industries in the area.

We make no apology for devoting so much attention to this subject; it is by far the most important matter before the electrical world in this country at the moment, and is likely to remain so for months and years to come. Any guidance that we can obtain from abroad that may help us in arriving at the right solution should be heartily welcome, and we must recognise that the supply of electricity in many respects has been more highly developed in the United States than in this country. The outstanding feature of the question here is the dominating position of the municipal or communistic element, which is practically absent from the American problem. We are not concerned to discuss the ethical or economic aspects of this subject—the question is whether it is possible to carry out the desired development and expansion of electricity supply under that régime; so far as the Electricity District Inquiries have progressed up to the present, the indications are unfavourable, and we must focus our attention most closely upon the matter with a view to directing our course into the path that will lead to a successful result.

The Freedom of the Press.

An interesting question has been raised in our "Correspondence" columns with regard to the discussion of the technical merits or demerits of specific materials or apparatus in those columns; on the one hand, we have been taken to task for permitting such discussions, and on the other, our action has been warmly supported by our readers. We agree with the latter that a very important principle is involved in the question, a principle which lies at the very foundations of the "freedom of the Press" which is so highly prized in British journalism, and our readers may rest assured that we shall not suffer that principle to be infringed in the smallest degree. In this respect we act in the capacity of trustees on behalf of the public; our first consideration at all times must be, as it always has been, the welfare of the nation in general and of the electrical industry in particular, and while we make no claim to infallibility, we must be guided by our own judgment in pursuing that aim.

On some occasions, with that principle before us, we have held it to be our duty to withhold from publication letters which undoubtedly were calculated to inflict serious injury upon British industries. To publish every communication that reached our hands, without discrimination, would be to betray our trust. But criticisms of technical devices, made in good faith, fall in a different category, and discussions of this kind undoubtedly make for good. That this is recognised by manufacturers generally may be inferred from the fact that objection on their part is almost unknown in our long experience.

Needless to say, nothing is farther from our thoughts than to inflict injury upon any individual or firm; on the contrary, if the subject under discussion is meritorious, the fact is sure to be brought out, and if it is defective, the sooner the maker realises the nature of the defects the better for him, as well as for his customers.

Protection for X-ray Workers.

The death of Dr. Ironside Bruce, late radiologist to the Charing Cross Hospital, due to exposure to X-rays culminating in blood exhaustion, has called forth a demand for an expert inquiry concerning the action of the rays upon the human body, from Dr. Robert Knox, president of the Röntgen Society. In a letter to *The Times*, Dr. Knox mentions the formation of a committee consisting of eminent physicists, physiologists, and radiologists, with a wide scope of investigation, which he places under four heads:—

1. The changes induced in tissues by X-rays, and particularly the effect on the blood changes.
2. The properties of the X-rays and the best means of controlling their action.
3. The equipment of X-ray and electrical departments with a special view to the protective measures employed.
4. Recommendations for the guidance of the assistants in those departments, particularly dealing with the hours of work and the need for fresh air and change.

In addition to this inquiry, Dr. Knox advocates the institution of co-ordinated research work. He acknowledges the very valuable services of individual workers, which, however, have barely enabled us to hold our own in the advances made since the discovery of X-rays. What is needed is a fully-equipped institute for the purpose, generously endowed for research in the three divisions of the field—physical, technical, and biological. As an outcome of the work of such an institute, means for protecting human lives from the harmful effects of the rays would be devised. Dr. Robert Knox concludes: "Surely it is our duty to put in action at once the steps necessary to help towards the achievement of this end," and in view of the large number of men who have suffered mutilation and death in their attempts to add to the sum of knowledge of X-rays and their application, we earnestly hope that Dr. Knox's appeal will not remain unheeded.

Electricity Supply in Paris.

A new agreement between the Paris City Council and the Compagnie Parisienne de Distribution d'Electricité has now been approved by the former, and the latter's concession has thereby been prolonged from June 30th, 1940, to the same date in 1944. In future the financial risks of working by the company will be at the charge of the City, although the latter will have the power to fix the supply prices in order to meet the high cost of fuel and labour and of new works. The pre-war tariffs of 50 centimes per kWh for lighting and 30 centimes for power supplied on the low-pressure system will remain the basis tariffs, but they will be periodically revised according to index figures for coal and wages which have been established. The sum of 1,700,000 fr. per annum which the company had to expend on new works will also in future be paid by the City, which will recover the amount from a "works fund" to be created by means of a levy on the company's receipts. At the same time the agreement modifies the share of the City in the receipts and the profits. The levy on the company's income, which ranged from 10 to 25 per cent. of the gross receipts formerly, will amount in future to 25 per cent. of the receipts calculated at the old tariff for lighting, 10 per cent. on the same receipts for power, and 5 per cent. on the receipts appertaining to the index numbers for coal. On the other hand, the City's share in the profits, which formerly increased with the latter up to 40 per cent., will now be at the uniform rate of 40 per cent.

TUBE TROUBLES IN WATER-TUBE BOILERS.

By J. CAUTHERY.

In a perfectly designed and constructed boiler worked under ideal conditions as regards feed water, firing, and supervision, there should be no tube troubles. Such a happy combination of conditions is rarely if ever to be found in practice, but in most cases tube troubles can be materially reduced, if not entirely removed, by attention to the advice given below.

Defects.	Causes.	Remedies.
Local Bulging.—This almost always occurs in the row of tubes nearest the fire, but rarely in the second or other rows. The bulges are usually of small area, from 1 to 15 square inches, and occur on the undersides or front sides of the tubes.	Overheating, due to the following causes either singly or in combination:—	Remove the tubes when bulging reaches ¼ in. down.
	(*a*) and (*b*) *Scale and Deposit.*—Scale and deposit composed largely of carbonates, and magnesia lime salts, are the most likely to cause overheating, because they make a very compact non-conducting medium in the transmission of heat.	Preventive measures:— (*a*) More frequent cleaning of tubes. (*b*) Better softening of feed water.
	(*c*) *Grease.*—It has been proved that grease amounting to as little as one-tenth of 1 per cent. in scale or deposit may send up the temperature of plates and tubes several hundred degrees. Steel rapidly softens after about 550 deg. F.	(*c*) *Grease.*—Prevent access of oil to the boilers in any appreciable quantity by more efficient degreasing, preferably done by combined coagulation and filtration methods. If such a plant is already in use see that there is a proper supply of chemicals, and that the filtering material is suitable and in good condition. Test deposit for grease occasionally; always when any bulging occurs.
	(*d*) Excessive density where the water in the boiler contains material proportions of salts or other matter in suspension.	(*d*) Keep down density by sufficient blowing down. Test density periodically by salinometer or fit boiler with a Porter densimeter gauge, which shows the density all the time. The density should not exceed 2/32nds as shown on the salinometer.
	(*e*) *Steam "Pocketing."*—Where circulation is defective steam pockets may occur in the tubes nearest the fire under severest conditions of firing. This is particularly liable to happen with some types of boilers.	(*e*) Should bulging still occur after eliminating all possible sources of tube trouble as above advised, the choice then lies between reducing the rate of firing or bearing with the tube troubles, or putting down extra boilers.
	(*f*) *Hard Firing.*—When any of the conditions referred to under *a*, *b*, *c*, and *d* exist, hard firing becomes a serious factor in contributing to overheating. Where tubes are clean and free from grease, and the water is not dense, and the circulation is good, a boiler may be very hard fired without the tubes suffering.	
Perforation.—Usually a small puncture at the apex of a bulge when the material has been thinned by repeated stretching until it is too weak to withstand heat and pressure. Sometimes perforation takes place without bulging as, for example, when perforation is solely due to corrosion.	(*a*) Overheating from the causes enumerated under bulging.	(*a*) Perforation requires replacement of tubes. If the perforation is due to bulging take preventive steps already advised.
	(*b*) Corrosion internally due to acid, or excessively alkaline or aerated feed waters.	(*b*) If due to internal corrosion consult best authorities as to prevention by suitable treatment of feed water.
	(*c*) External corrosion due to dampness.	(*c*) If due to external corrosion find out cause of dampness, and prevent it. Sometimes it is due to steam jets or excessive moisture in fuel, or with oil firing to moisture and sulphur in fuel.
Rupture or Explosion.—In these cases the tube is rent open, and a gap formed, sometimes of large dimensions, through which the contents of the boiler rapidly escape. These ruptures are a source of danger to those about the boilers. The Board of Trade expect these occurrences to be reported to them under the "Boiler Explosion Acts."	(*a*) Overheating from causes described under bulging.	(*a*) Prevent overheating.
	(*b*) Partial or complete stoppage of circulation in the tube due to accumulation of deposit. This has been the cause of many tube explosions, and is often overlooked by investigators.	(*b*) At cleaning times see that cleaners are pushed right through tubes to back or bottom ends. In boilers of the upright tube type cleaners sometimes brush scale and deposit down the tubes, and there is danger of blocking the tubes up, especially bent tubes. With header types of boilers deposit may not be pushed out of the tubes at the back ends, and there is the greater chance of this should the back header caps not be removed at the cleaning time.
	(*c*) Failure of weld.	(*c*) Lap welded tubes were used to some extent during the war. The failure of lap welds from defective manufacture rarely occurs, however, apart from some contributory overheating. There is now no necessity to use other than solid drawn tubes.
	(*d*) Faulty tube due to material being of uneven thickness or laminated.	(*d*) This is fortunately of extremely rare occurrence. The only safeguard is careful inspection at the makers' works or before insertion in boilers.
"*Hogging.*"—This defect consists of the arching of the first, and sometimes the second row of tubes over or in front of the fire.	(*a*) Hogging, generally due to repeated slight overheating.	(*a*) Remove causes of overheating where possible, and where "hogging" reaches about half the tube diameter from the straight replace the tube.

Defects.	Causes.	Remedies.
Sagging.—The tubes usually bend downward in the case of diagonal or horizontal tubes, and forward in the case of vertical or nearly vertical tubes. Sometimes they also bend sideways.	(*a—e*) *Sagging.*—Overheating due to the low water, or to firing the boiler without any or insufficient water in it.	(*a*) Frequent testing of water gauges. (*b*) Have a good light on the water gauges. (*c*) Have all water gauge passages opened and cleared at stoppages. (*d*) If any low water alarm is attached, see that it is in order before closing up boiler, and test occasionally when working. (*e*) See that the blow-off valves are closed and tight before starting up.
Blisters.—Swellings on tubes, generally in vicinity of fire, having appearance of bulges.	(*a*) Blisters are due to laminated material, *i.e.*, to it being in layer or layers and not homogeneous. This defect is covered by the presence of impurities in the body of the steel. Overheating occurs at this point from interrupted transmission of heat and the layer nearest the fire swells and shows the appearance of a bulge. A blister can generally be differentiated from a bulge by the spring back of the hammer on testing.	*a.* Unless the blister be a thin one, say, not exceeding 1/32 in. full, the tube requires renewal.

A METHOD OF CHARGING FOR IDLE CURRENT.

By C. G. CARROTHERS.

The present increase in the demand for a.c. supply by every description of power user has convinced most power supply companies that if they are to make as good use of their stock as before, it is necessary that means of inducing consumers to take their supply at a high power factor should be devised. It is now a matter of common knowledge that the transmission of power at a low power factor demands unnecessary expenditure in new mains and limits the possibility of connecting further consumers to existing mains. There is also an undue waste of power through carrying needlessly heavy current for a given power, the cost of which varies inversely as the square of the power factor. Beyond these widely appreciated effects of a low power factor, there is now a disadvantage not hitherto encountered. The amount of power which is being linked together on the larger systems demands that stations operating in parallel with each other, or even the different bus bar sections of one large station, should not be coupled directly, but should be coupled up through current-limiting reactances. Stations connected with each other in such a manner are not able to assist each other in supplying the wattless current demanded by the loads on their bus bars unless a different voltage of operation is allowable at each station. The sets coupled to a section which is having power fed into it must, therefore, supply the wattless current for the power which they are generating, and also that corresponding to the power which is being fed in. This condition may make regulation so difficult that it is impossible to run the sets on the assisted sections at their full capacity, unless the power factor of the load on that section is above normal. (This point may be more readily understood by the examination of vector diagrams such as are given in a paper by Messrs. K. M. Faye-Hansen and J. S. Peck, published in Vol. LII, p. 511, of the I.E.E. *Journal*.) The above considerations are sufficient to justify any attempt to secure a high value for the power factor of the load taken by consumers.

The only methods of improving power factor which are at all practicable at present lie with the consumer. He should, therefore, be induced to make use of them by a clause in the rate book, the clause being worded and operated so that the consumer's savings due to an improvement in power factor are immediately apparent to him. The readings necessary should not involve the use of complicated or unusual measuring instruments. Also, they should show the amount to be charged without any cumbrous computation. The rate charged per unit should be equitable, if possible, so that the supply company is recompensed for the expense of supplying wattless current, while the consumer is not unduly penalised.

To fix these rates we must first examine the components which, added together, give the total cost of supplying power. Suppose we say that p pence covers the cost of generating one kWh, and q pence is the cost of transmission of one kVAh, including capital charges and maintenance and a percentage for profit. Then the amount to be charged should be:—

$$(p + q/\cos\phi) \text{ per unit of true power.}$$

Prof. R. Arno has devised a method of modifying ordinary integrating wattmeters so that, with a flat rate per unit indicated, the consumer is charged an amount exactly corresponding to that given by the above law. This method does not seem to be used as much as it deserves to be, possibly because it has not yet had time to become sufficiently widely known. There is also the possibility that consumers might not favour the use of an instrument which for reasons outside their understanding reads at a non-uniform rate.

A more favoured practice at present is to equip the consumer with two of any type of integrating watt-hour meter. One of them is connected in the usual way to register kWh, and the other to register kVA sin ϕ. h.

This is easily arranged in any polyphase system, and demands merely a change-over of connections without the use of any other apparatus beyond that usually required. From the ratio of the readings the average power factor is deduced. The consumer is then subject to a rebate or penalty of, say, d pence per 1,000 units for each 1 per cent. by which his power factor is greater or less than a value laid down in the rate book. That is to say, if x per cent. is the power factor as found from the meters, and C pence is the cost per unit at a power factor of X per cent., then the amount charged per unit $= C - (X - x)d/1{,}000$ pence.

This system has the advantage of being easily understood, and is readily accepted by consumers. It has the disadvantage that there is no longer a flat rate for power, since each customer must have two meter-readings taken, his power factor calculated, and from that a rate per unit deduced. Account-keeping is therefore no longer a simple matter. The word "penalty" may also prove alarming to prospective consumers. A less important shortcoming of this method is that it is based on a straight-line law, so that it cannot be made to correspond with the hyperbolic law:—

$$\text{cost per unit} = p + q/\cos\phi$$

except over a short range of values of power factor.

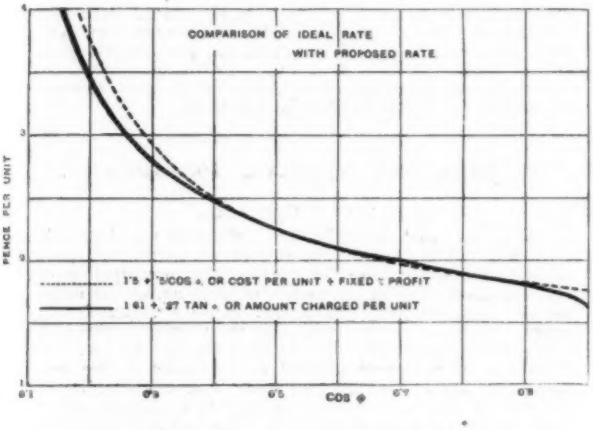
With the instruments at present available, the following gives a method of charging according to power factor which combines the consistency of Prof. Arno's meter with the simplicity of the second scheme. As in the second method, the customer has two standard meters which read: kVA cos ϕ . h and kVA sin ϕ . h respectively.

For each meter a separate account is kept, each at a different rate per unit indicated. If he is charged a pence per unit indicated on the true power meter and b pence per unit shown on the other, then for each unit of true power consumed he will be charged $(a+b \tan \phi)$ pence.

We must choose values for a and b such that

$$(a+b \tan \phi) \text{ approximates to } p+q/\cos \phi$$

for as wide a range of values of $\cos \phi$ as possible. Let the two be exactly equal for $\cos \phi = 0.5$, $\tan \phi = 1.73$, and $\cos \phi = 0.85$, $\tan \phi = 0.62$, a condition which is satisfied by putting: $a=(p+0.72\ q)$ and $b=(0.74q)$, so that if p be taken as, say, 1.5 pence, and q as, say, 0.5 penny, true power is charged for at 1.61 pence per


COMPARISON OF IDEAL RATE
WITH PROPOSED RATE
PENCE PER UNIT
1·5 + ·5/COS φ OR COST PER UNIT + FIXED % PROFIT
1·61 + ·37 TAN φ OR AMOUNT CHARGED PER UNIT
COS φ

unit, and wattless kVA at 0.37d. per unit. The accompanying curves show $1.5+0.5/\cos \phi$ and $1.61+0.37 \tan \phi$ to give nearly coincident values for all values of $\cos \phi$ which are likely to be met with in practice. (With the points of intersection chosen, the rates would be suitable for loads with power factors ranging from 0.4 to 0.92. If desired the points could be chosen differently.)

An improvement in power factor is shown by a decrease of units indicated on the idle current meter, which is directly proportional to the saving effected. The appeal to the customer is, therefore, both simple and direct. We must also not neglect the fact that the idea of paying at a flat rate for something which has been indicated on a meter is not one which involves any new habits of thought on the part of the non-technical consumer. On the other hand, the introduction of rebates and penalties for something which he does not understand, and for the existence of which he has only the assurance of the supply company, is to ask him to take rather much for granted. This may seem a minor point, but as already pointed out, the question of rate adjustment demands that some attention should be paid to psychology. The fact that there are two flat rates gives simplicity of computation of accounts without any special form of calculation, the only change being that each consumer has two accounts instead of one as hitherto.

American Copper Mines Closing.—The North Butte Copper Co. has ordered a suspension of production, and other companies are expected to follow this example where the properties are unprofitable at present prices of copper. This will result in an estimated monthly reduction of 30 to 40 million pounds in the United States surplus stocks.—*The Times.*

Electrical Goods in South Africa.—The *South African Engineering and Mining Journal* in its issue for February 26th, 1921, says:—Dealers report that business in electrical goods is improving, and that orders are coming in from all parts of the country, East Rand, Kimberley, &c. Electrical materials, with the exception of half-watt lamps, which are still anxiously awaited, are arriving regularly, and nearly all the more important lines are now fairly well stocked. Prices generally are very firm, and show no present indication to fall.

THE UNITED STATES SUPERPOWER SURVEY.

The complete report on the superpower survey of the Atlantic seaboard now being made by the Geological Survey will not be ready before the end of June, but a brief statement showing the progress made so far was made recently by the Secretary of the Interior, Mr. J. B. Payne, to President Wilson, and was published in the *Electrical World* of March 5th. An abstract of it follows.

An organisation was effected under the Geological Survey with Mr. William S. Murray as chairman of the engineering staff, which has been aided by an advisory board of business and professional men. [See Electrical Review, June 18th, 1920, p. 797.]

Having in mind the objects of the Superpower Survey, namely, (1) allocation of the amount of waste in labour, coal and other materials due to the improper form of power generation and distribution within the Boston-Washington zone, and (2) recommendations regarding a regional power system by means of which these wastes may be eliminated, the superpower report naturally divides into three divisions—(1) physical, (2) legal and (3) financial.

With regard to the physical aspect the investigation has been concerned with power necessary to (*a*) railroads, (*b*) industries, (*c*) utilities, and (*d*) a system of centralised electric generation and transmission to supply their power requirements through 1930.

Railroads.—It is found that twenty Class 1 railways are included in the superpower zone; total trackage (including yards and sidings), 36,000 miles. There are 10,000 steam locomotives, of which 44 per cent. are freight, 29 per cent. passenger and 27 per cent. switching. The total annual railroad coal consumption for 1919 was 19,000,000 tons.

Apparently one-third of this mileage can be economically electrified. Owing to lack of traffic density upon the branch lines, these cannot be profitably electrified. The above 33 per cent. of mileage will carry more than 50 per cent. of the traffic, and by preferential arrangement of routes probably 60 per cent. of the total traffic could be put over this mileage. Through the electrification of the above mileage a fuel saving of 6,000,000 tons, or $40,000,000 yearly, would be effected. Added to this saving will be $50,000,000 annually in favour of electric *v.* steam engine repairs and maintenance.

The total unit cost of electrification will be approximately $40,000 per mile of main-line track, which with 12,600 miles to be electrified would cost $500,000,000. In addition, yard and siding trackage would call for $300,000,000, or a total of $800,000,000. This sum will cover the necessary construction and equipment for the railways.

The electrification above outlined will displace approximately 7,000 steam locomotives, which at a salvage value of $22,500 each will credit the electrification estimate with approximately $150,000,000, leaving a net investment of $650,000,000, which taken in connection with aforementioned savings of $90,000,000 per annum would return approximately 14 per cent. on the investment.

Industries.—There are approximately 50,000 industrial plants in the zone which either purchase or generate power. The Bureau of the Census is at present compiling the statistics of the 1919 Census of Manufactures. From the data at hand a saving of between 6,000,000 and 8,000,000 tons of coal is indicated. In the anthracite coal mines of Pennsylvania, by means of electrification and the supply of superpower, a conservative estimate based on actual tests shows a saving of 6,500,000 gross tons of anthracite. The Survey is preparing estimates for completely electrifying the anthracite mines.

Utilities.—A large saving of coal can be effected through the more efficient generation of power by the new superpower stations. It is found that the average rate of consumption for present central-station output is 2¼ lb. per kWh. Power can be produced in the superpower system at an average rate of 1¼ lb. per kWh. The present central-station output of coal-generated power within the zone is 8,000,000,000 kWh. Therefore one pound saved per kWh will conserve 4,000,000 tons of coal annually.

Electric Power Generation and Transmission.—The location of the large superpower stations and their attendant transmission lines is related to the establishment of load centres throughout the superpower zone to which power will be transmitted from them at minimum distance. To date it is indicated that some twenty load centres will be established. By March 1st sufficient data were expected to be at hand to establish these load centres, after which the location of new superpower stations and their interlinking transmission systems could be promptly determined in the zone.

The development of power outside of but for transmission to the zone is being most carefully considered, having relation to the St. Lawrence River, other hydro-electric powers and the bituminous coal mines. It has been agreed among the experts of the country that 250,000 volts will be an acceptable voltage for the transmission of power over distances greater than 200 miles and about half that value for the zone itself.

A conference with the coal authorities indicates that a fair figure to take for the average price of coal during 1919 was $2.90 per ton at the mine, and during the period from that date to 1930, $3.50 per ton.

With regard to water power for the zone, a summation of

the possible outputs indicates that for an average year there will be available 12,000,000,000 kWh and for a minimum year 8,360,000,000 kWh, the plant capacity being 2,300,000 kW to furnish this amount of energy. It is of interest at this point to state that in 1930 the total power requirement in the superpower zone indicated by projected growth curves will be 48,000,000,000 kWh, of which amount the superpower system could supply 36,000,000,000 kWh. This, therefore, indicates that the water-power supply can be but from 20 to 25 per cent. of the total. This fact forces the conclusion that most careful consideration must be given to the efficient development of power from coal.

The report will contain a chronology indicating time and location of superpower stations to be constructed in the order of their requirement, giving savings to be effected as their serial installation is made.

Through the unusual co-operation of the public utilities, the railways and the industries the completion of the work will be, after May 1st, substantially a matter of computation and tabulation.

Legislation.—Legislation should take the form of an Act permitting the formation of a corporation authorised to take by eminent domain lands or interests therein necessary or appropriate to the construction, maintenance and operation of lines for the transmission of electric energy. Such legislation may be by a separate Act or by an amendment to the Federal Power Commission law.

As a condition precedent to the formation of such a corporation the proposed incorporators should be required to apply to the Federal Power Commission for a certificate that the project is desirable and is justified in the public interest. This application should be followed by a hearing after due notice to the governors of the States through which condemnation rights are asked. If the certificate is granted, the incorporators should be permitted to form a corporation with the usual powers and in addition thereto (subject to the approval of the utility commission of the State where the power is to be exercised) the right to construct, maintain and operate power plants and transmission lines and the right to purchase electrical energy from and sell it to electrical power producing and distributing companies. All of these rights should be subject to the exercise by each State of its full police and taxing power.

It will be observed that herein no new right is created as against any State, except that of taking by eminent domain the location of a transmission line for the transportation of electrical energy in interstate or foreign commerce. Each State retains unimpaired power to fix rates, to determine the character of structures and to lay and collect taxes to the same extent as such authority is exercised over power producing and distributing corporations of its own creation.

Financial.—The plan of financing which has been suggested is based on the supposition that the superpower system is in its very nature an extension of present power supply systems whereby, combining several large plants with present relatively small plants, economy in generation and conservation of natural resources can be secured over that at present attained. Therefore the vested rights of existing public utility power generating and distributing companies should be protected.

Dependence must be placed on the incentive of private initiative to lower costs and on some form of public regulation of prices to the consumer. The power generated and distributed by the superpower system will finally be distributed to the public by means of existing companies, and the economies to the public utility companies which will result must ultimately be reflected in prices to the consumer through the action of the State regulating bodies.

The financial plan in bare outline provides for a superpower company with non-par stock as its only class of security. The public utilities within the Boston-Washington zone are to be entitled to subscribe for this stock, pro rata, based upon capacity demand and load factor, stock not taken by these customers of the superpower system to be offered to public subscription.

A contract between the superpower company and a local public service company would be a selling contract or a buying contract, while in many cases both buying and selling of electrical energy would be involved. These contracts, on which the State regulatory bodies would pass, would be adjusted from time to time to meet the progress of the art and changing conditions, whether favourable or unfavourable to costs of operation.

Returns upon the stock of the superpower company should be limited by specific provision to a fair division of the benefits derived from its operation between the investing public and the consumers that will make it possible for the superpower company to come into existence and at the same time be able to serve the public adequately. New capital is the keystone of the project, but the public demand is its foundation. This division of benefits would be attained by a rule under which the customer companies would participate equally with the stockholders in any distribution, at stated intervals, of net earnings in excess of a specified rate of return, which itself should be more liberal than is commonly contained in the idea of public regulation. Thus efficiency in management would be rewarded and the public interest directly served. To secure the participation of the ultimate consumer in this division of benefits, provision should be made that the superpower stock held by any public service company be regarded as representing an extension to its existing station capacity rather than an outside investment security.

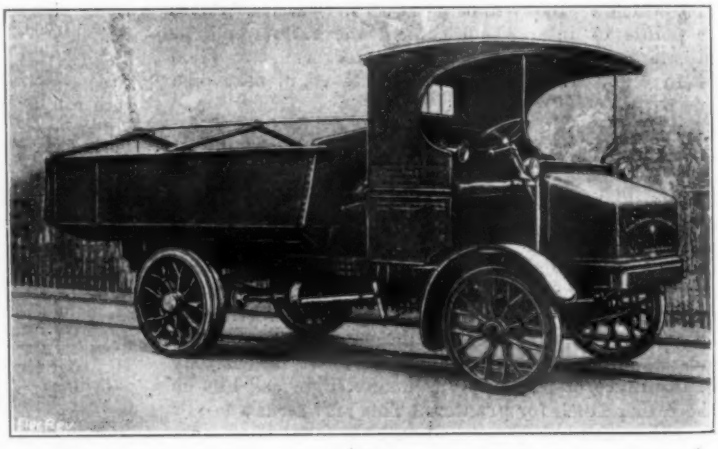
Absolute publicity of the superpower company's operations will be an essential condition. Freedom of action should, however, be also sought for this company in order to promote the free flow of capital to this enterprise, whose requirements will be large and continually increasing.

The prime object of the superpower plan is a larger supply of cheaper power. The superpower survey looks to the full utilisation of all resources, and conservation of the country's fuel cannot be attained except with the aid of large capital investment. Neither the nation, by coal conservation, nor the individual consumer, by lower rates, can profit by the project, however sound in its engineering and economic phases, unless the conditions of financing are sufficiently attractive to warrant the use of the country's financial resources.

ELECTRIC VEHICLE PROGRESS.

A New "Electricar."

During the past year Messrs. Electricars, Ltd., have been engaged in very considerable experimental and research work in connection with the needs of the municipal engineer and surveyor. One of the results of their activity is depicted in the accompanying illustration. It is considered by its makers that this electric vehicle is the nearest approach that has yet been made to the ideal municipal wagon. Perhaps two of the most difficult requirements of the refuse-collecting wagon are: Adequate carrying capacity, and the keeping of the body sufficiently low to enable the filler to work without the use of a ladder. The first is a very difficult factor, owing to the different conditions which obtain in each town, but its importance is apparent when it is considered that no vehicle can be earning anything for its owner while it is standing idle being loaded. It is, therefore, essential to determine the correct carrying capacity of the vehicle in order to avoid wasting the time of the vehicle on the one hand, and wasting the time of the fillers on the other. In practice, it has been generally found that the 40 or 50-cwt. Edison accumulator wagon has been the most economical unit to employ for this class of work. With regard to the second requirement, it is almost unnecessary to say that while the old method of using a ladder to load the van with horse-drawn vehicles was tolerated, it is absolutely ruled out in the case of mechanically-propelled vehicles owing to the enormous waste of time involved. In the case of the wagon under consideration, Messrs. Electricars, Ltd., have endeavoured to keep the loading line sufficiently low; in this instance it is 5 ft. from the ground, which means loading from the kerb at a height of 4 ft. 8 in.



An "Electricars" Municipal Tipping Wagon.

B.E.V. "Super Giant" Trucks.

Messrs. British Electric Vehicles, Ltd., several types of whose trucks have been described in our pages from time to time, have received instructions from the Port of London Authority to supply 31 of their "Super Giant" electric industrial trucks. We are informed that the order

was placed after exhaustive tests had been carried out on various types of vehicle, including trucks made by the leading American manufacturers, not so much from the point of view of price, as from that of actual performance, accessibility, and simplicity. As an example, the following facts may be mentioned: The motor can be replaced with a new one in under ten minutes; the countershaft can be taken out and replaced in the same time, and the controller can be removed without disconnecting any of the wiring and without taking out any bolts, the time required being under five minutes.

All other parts of the truck are also easily accessible for either repair or adjustment, and the electrical equipment consists of one of the firm's standard motors to run at 40 volts, 1,200 r.p.m., 1 b.h.p., constant rating. The battery consists of 20 cells, Chloride Exide-ironclad, I.M.V.5 type, rated at 161 Ah. The efficiency of the motor under normal running conditions with the truck fully loaded, running on a hard level track, is 80 per cent., the current consumption being from 30 to 32 amps. All running parts are fitted with ball or roller bearings, Skefko bearings being used for the motor, differential gear and countershaft, and British Timken roller bearings for the wheels.

The controller is of the firm's standard pattern, fixed under the platform of the truck in a dust-tight case, and embodies a number of special features, namely: The drum can be taken out without dismantling any parts; the fingers are adjustable and are held in contact by springs; the trip gear, which is interlocked with the brake, interrupts the main circuit when the brake is applied, and the controller can be taken out without disconnecting any of the wiring.

It is particularly pleasing that in this instance the order has been kept at home instead of going to America, not as a question of sentiment, but on results.

A New "D. P." Vehicle Battery.

Storage batteries used to propel electric vehicles are required to withstand the most trying conditions that are met with in battery practice—overcharging, under-charging, standing discharged, discharging at excessive rates, neglect, rough handling, and, above all and worst of all, incessant vibration when in use—and it is marvellous that batteries have been produced which can successfully endure such treatment. As a matter of fact, the list of types which have made good is exceedingly short. The announcement of the D. P. Battery Co., Ltd., that it has developed and put on the market a new traction battery is therefore of exceptional interest, and we have taken an early opportunity of visiting the company's offices to inspect the newcomer. It is a lead-plate battery, of the pasted type, and has been subjected to prolonged trials in actual service, as a result of which the makers confidently put forward for it some remarkable claims, chief of which is that the cells never require cleaning out. That implies, of course, that the active material never falls to the bottom of the cell, for which reason the clearance space beneath the plates is greatly reduced. The plates are of high capacity but very strong construction, and the separators are of a special material applied in such a way that the active material is permanently retained in position. The capacity of the cells is therefore maintained longer than would otherwise be the case, and the important advantage is gained that the plates, during their whole life, never need be removed from the boxes and exposed to the air, a process which is well known to be very detrimental to them. The cells are generally similar in appearance to other lead batteries, and are made to the dimensions standardised for electric vehicles. We are informed that the watt-hour capacity of the cells per pound of battery is exceptionally high, implying that the internal resistance is low. The cells are capable of withstanding high rates of charging and discharging, and the British Electric Vehicle Co. has furnished particulars of a trial run of 80 miles with a battery of 42 "TR" 13 type "D. P." cells, rated at 145 Ah at the 5-hour rate of discharge. At the start the specific gravity of 1.265; on the outward journey of 40 miles, 110 Ah was taken out of the battery, which was then put on charge at constant voltage, for three hours, starting at 40 amperes (sp. gr. 1.200) and finishing at 20 (sp. gr. 1.250). On the return trip 100 Ah was taken out, the specific gravity falling to 1.175. The B.E.V. Co. considered these results "somewhat in the way of a record."

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A "Universal" Ceiling Rose and Connector Box.

Messrs. Edward Wilcox & Co., Broadway Corner, Trafford Road, Salford, have sent us particulars of a "universal" ceiling rose, connector box, &c., for any situation, and suitable for any wiring system.

The device consists of a base of porcelain or other suitable insulating material (fig. 1), having four openings leading from a central hole, each opening being provided with a tapped (or square dovetailed) blind hole into which are inserted as many terminals (fig. 2) as are required to make a two, three, or four-plate ceiling rose or junction box. The circuit cables are led through a central hole in the usual hardwood pattress, and the base is slipped over and secured to the wood block by three screws. The cables are bared in the usual way and the conductor is bent round the castellated terminal centre screw, a sound mechanical and electrical connection being effected, also ensuring that the conductor is insulated right up

Fig. 1.—Universal Base.

Fig. 2.—Terminal.

to the terminal. The flexibles for the pendant are secured to the same terminal screw, under the top washer. The design of the terminal leaves no back connections or screws to corrode and no side screws to tempt the wireman to leave to chance, all connections are at the front and straight. With the use of "cab tire" sheathed cables and a cover as shown in fig. 3, filled with suitable compound to cover terminals and a rubber ring to cover fixing screws, the device may be used for wet or

Fig. 3.—Cover for Base.

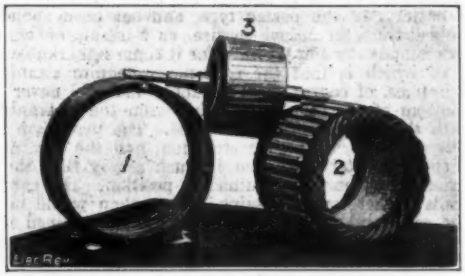
corrosive situations in chemical and similar works. The ordinary type of ceiling rose cover may be used for ordinary situations, but the one illustrated is suitable for either with the addition of the compound filling only for special situations. A plain cover may be used to convert the device into a junction box for either wet or dry situations.

A New Stator Construction.

Mr. Alexander Zarky, 930, W. Temple Street, Los Angeles, Cal., U.S.A., has sent us particulars of a new design of stator for a.c. machines for which patents are pending. The chief aim of the design is to simplify winding or, better still, rewinding, especially in the case of fractional h.p. machines where limited space makes the work very difficult. It will be noticed from fig. 4, p. 408, that the finished product has the effect of a closed channel type of stator, a type which, although ideal electrically, is a rarity, owing to the commer-

cial impossibility of winding such types for voltages requiring numerous inductors.

In this device, instead of a one-piece core stator with inner teeth, a two-piece stator of concentric ring construction is used. No. 1 in the illustration is the outer ring fixed to the frame. No. 2 is the inner ring with an inner web at the bottom of the outer teeth giving it the appearance of a d.c.



(1) Outer Ring. (2) Toothed Core. (3) Rotor.

Fig. 4.—A New Stator Construction.

armature. After winding the slots, the inner ring is pushed into position in No. 1, and a mechanical and magnetic contact is effected by having the bore of the outer ring and the outer diameter of No. 2 slightly tapered. The rotor can be of the usual types.

Electric Starting on Crude Oil.

Messrs. Vickers-Petters, Ltd., the pioneers of semi-Diesel crude oil engines, have perfected an electric starting device, which can be supplied with all sizes of oil engines manufactured by them. It enables the engine to be started instantly on crude oil without external heating, and dispenses

Fig. 5.—Crude Oil Engine Starter.

with the need for paraffin. The device consists of a patented electric torch, to which current is supplied through a battery charged by a dynamo attached to the engine. As soon as the engine is started, the current is switched off and ignition maintained by the heat of combustion. The torch is only exposed to the heat of combustion for a few minutes, and is not liable to be burnt out. The equipment includes two storage batteries for 100 ampere-hours, one being a spare, one spare heating element, and a complete generating set with switchboard and instruments for charging the battery from the engine. A lamp switch is also provided, enabling one or two electric lights in the engine room or elsewhere, to be connected to the battery.

Keeping Wires straight when being Pulled into Conduit.

Where a number of conductors are being pulled into a conduit, such as the connections between a controller and its resistance or motor, from a field-rheostat dial and operating

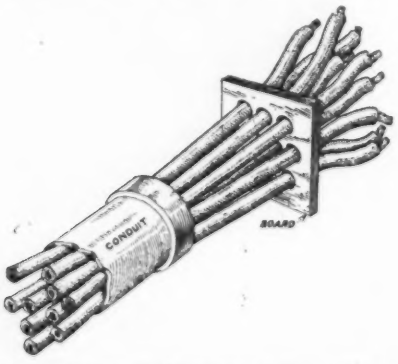


Fig. 6.—Arrangement of Conductors when being Pulled into a Conduit.

mechanism on the switchboard to the resistance some distance away, &c., the problem of keeping the wires straight and properly laid up during the pulling-in process is always present. The scheme illustrated in the figure solves the problem very nicely.

In a piece of board a number of holes are bored, and through these the wires are passed and then connected to the pull-in line (fig. 6). When the wires are connected the board can be held away from the end of the conduit by a man while the wires are being pulled. Since the holes in the board hold the conductors in a given position on entering the conduit they will maintain this position throughout the latter's length. This greatly facilitates cabling up, as the wires occupy practically the same relative position in each end of the conduit. When they are tested out, the top conductors at one end will be found on top at the other and the bottom conductors at one end on the bottom at the other, which is seldom the case excepting where some means is provided to hold each wire in a given position in the cable.—W. A. Harris in *Power*.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday will not appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The North-East Coast Power Companies.

It may readily be conceded that the primary object of your leading article in the Electrical Review of March 11th, 1921, is synonymous with the aim of the writer of this letter, viz., to help to secure to the national industries the cheapest possible supply of electric power to enable home industries to compete in the markets of the world. But your commendation of the North-East Coast electric power companies is unfortunate, in view of the methods of that combination, and of the misuse of Parliamentary powers it has acquired and has exercised without the sanction of Parliament in a manner inimical to public interests. It is also somewhat unfair to your readers in so far as your comments give the impression of successful development, the genuineness of which is at least open to doubt. Should not the performances of the Newcastle group of power companies rather be regarded as a public danger than held up as an example? Surely you have not fallen into the common error of mistaking a goliath growth for a healthy development.

It is puzzling to know the data on which business experts of your experience repeat the claim of successful electrical development in the North of England, which claims up to now have always proved to be but an echo of the vaunting voice of the combination itself. Where are the independently verified figures obtainable? The statistics of the North-East Coast companies are not to be found in the directors' reports, and they are not to be found side by side with those of the other companies and all the municipal electrical authorities in the kingdom, in the published tables of the electrical Press. Is it not rather a fact that properly audited figures and independently verified statistics of the Newcastle group of power companies do not exist, and that the combination is a law unto itself in spite of the statistics prescribed by the Board of Trade to other undertakings, who readily and freely publish their figures, as all the owners of State-granted powers ought to do?

If the successful development you commend means the lowest possible price of electric power to the national industries and a fair return to the private investor, then success has not been achieved under the holding company system practised by the Newcastle group of power companies on the North-East Coast. On the contrary, it has meant the ruin of certain sets of investors on the one hand, and extravagant rewards to another section, while the consumer can only receive such portion of the benefit of reduced costs or improvements in working as the combination "ex gratia" chooses to bestow. The introduction of intervening and holding companies which have been depleting the revenues of Parliamentary undertakings for no adequate service, supplying plant at enormous prices far above cost, vending at the holding company's own price all the electricity required by a Parliamentary undertaking, is a most unsatisfactory condition of the affairs of a State-granted monopoly.

I recognise that you are seeking, as I am also endeavouring to seek, to be of service to the well-being of the national industries. With such knowledge as I have, the lowest possible prices of electric power seem to be impossible of attainment under the existing methods of the Newcastle group of power companies. How is the effect of past abuses of Parliamentary powers to be remedied and proper safeguards imposed, except in the first place by the impartial and independent investigation advocated in my pamphlet, a copy of which is enclosed for your information?

The fact of the Newcastle group having done useful pioneer work, which must be admitted, ought not to be a justification for continuing their methods. I would be pleased to hear from you, especially as you are more in touch than I am with the new conditions under the Electricity Commissioners. It does not appear that they have the power to investigate past performances of the North-East Coast companies in the

manner they ought to be sifted before the operation of so important an area is entrusted to them under the 1919 Act. Any information that would modify my views would be acceptable. I am open to conviction if shown to be wrong. I would only be too pleased to rectify any apparent injustice my present attitude may be doing to the combination or to industrial interests. My aim has been to help electrical progress in the right direction, although shareholders whom I have addressed from time to time, have never been able to see it, the subject is so complex.

With the one exception I think your article is most useful and instructive.

Andrew Gemmell.

Ovingham-on-Tyne.
March 16th, 1921.

[We print with some reluctance Mr. Gemmell's letter (which we rather expected to receive)—reluctance, because of the pressure on our space; but it were better to risk misapplying the space than to risk the suppression of truth or the perpetuation of injustice. If our correspondent is mistaken, the companies are too well established to suffer injury; if he is in the right, the facts should be known. It seems that the "short point" of his complaint is simply that the companies do not publish the details of their business; this does not strike us as a very reprehensible procedure. On the other hand, while we hold no brief for the companies, we are impressed by the fact that Mr. Gemmell's campaign, extending over many years, has elicited no support from any quarter, and the companies appear to be in good standing and repute with their consumers, amongst whom are numbered many of the largest manufacturing concerns on the North-East Coast, and many municipal authorities. It would, no doubt, be a very good thing if the companies would meet Mr. Gemmell's charges once for all, and settle a question which is becoming somewhat time-worn; but the fact that they are silent by no means presumes their guilt. Our own view of the companies' activities has already been expressed: it is, in fact, the item with which Mr. Gemmell disagrees.—Eds. Elec. Rev.]

The Life of Metal-filament Lamps.

Holding a, perhaps, unique position in the lamp industry, and having read with much interest the correspondence on the above subject, and closely examined many thousands of the "dear departed," I would like to suggest that one real reason for the short life of the vacuum-type lamp is that of rough and unsuitable usage, for it should always be remembered that a m.f. lamp cannot be handled with the same freedom as a carbon type. This fact alone would appear to be responsible for more than half the complaints of short life.

With regard to the "gasfilled" lamp, the case is perhaps a little different, for there is here a very real defect which, no doubt, will be eliminated in the course of time by the manufacturers, and no doubt your correspondents will find the life of "gasfilled" lamps increase beyond that of the vacuum type—if they will exercise their patience a little longer and not forget that the manufacturers' and consumers' interests, after all, are almost identical.

Ita Est.

March 22nd, 1921.

Payment According to Ability.

When I wrote you my idea of low production and payment by ability I meant just what I said. By ability I mean doing a fair day's work, and doing it well. I don't believe in scamped work, though I've seen plenty of it done.

There is no doubt that "Another Regular Reader" was the best man on the job he got sacked over.

I still hold that the average man after serving his apprenticeship and having 15 years' experience is a better man than the average man of 21. If he is no good then, I should give him a broom, and let him sweep the shop up. I don't care whether a man is married and has children or not, if he applies for a job and expects the same wage as other men he should be capable of doing his work. What is technical training? It is only one way of gaining experience. He says, himself, that he failed to pass a test; well, he failed through want of experience.

To my idea, fear of unemployment through more production is utter nonsense. Can't a man be quick at his work and do it well at the same time? Is "Another Regular Reader" one of those that think a man is too old at 40?

If a foreman or manager cannot tell which are his best workmen he must either be silly or blind.

Regular Reader.

March 20th, 1921.

The Training of Kinema Operators.

Apropos of your note *re* kinema operators and their ability as electricians (in your issue of March 18th), I should like to say that I think most of the fault lies with the tuition at some of the institutions where operating is taught. I myself had tuition at one of these, and I must say that had I not possessed a thorough knowledge of electrical and mechanical engineering already, I should now have been considerably at sea.

I certainly agree with your correspondent's remark that so long as they can turn the handle or switch on and thread up the projector they think they are first-rate operators.

For instance, at the institution attended by me they had in the theatre a petrol generating set. Many pupils who came down would say: "What is that?" and the only satisfaction they received was to be told: "It is a generator." They were not told of its construction, or its working, or instructed in any way as to its care, and during the period of my attendance it was not even run, but I noticed that one of the operator instructors spent much time in cleaning it.

Also I might say a few words in connection with the working of the arc and gear with which it is controlled.

In the school theatre in question there were (as is the case in most kinemas) two projectors, but unlike the commercial units, no change-over switch was fitted—there being a double-pole two-way knife switch only. Consequently none of the pupils received instruction in the management of this, and the necessity of cutting down the current to the required level while the two arcs are momentarily burning together. This, of course, is done automatically in the case of the change-over resistance and switch combined, but all kinemas are not necessarily fitted with this type.

The only opportunity given to the pupil to grasp all these technicalities is one evening's actual experience in the operating box of some kinema to which he is sent by the school.

Therefore, I do not see how these men can be necessarily described as electrical engineers unless they have taken the greatest interest in their work, and augmented their electrical knowledge during their spare time.

Could not this be done in the same way as some of the apprentice engineers are doing it—by attending a course at the polytechnics in the mornings? or, better still, kinema proprietors should insist that the schools teaching the would-be operators should give them a thorough technical and practical course of electricity and its application to the kinema.

Thornton Heath. **F. C. Dreier.**
March 24th, 1921.

An Electrostatic Phenomenon.

In reply to Mr. F. Cooper, many years ago I experienced the same phenomenon. A number of 100-V carbon filament lamps had become charged in the manner described by being in close proximity to a quick-running dry leather belt of a Robey engine and dynamo. On a lamp being touched by hand on the brass collar, one had a nasty shock when the lamp discharged to earth. If a lamp was held by the bulb and placed close to the belt, but not touching it, a lightning display was noticed all over the outside of the bulb, and the filament of the lamp lashed up against the sides of the bulb. It was possible to light a gas jet when the brass collar was brought near the gas burner with the gas on.

I have many times tried since to charge lamps up in a similar manner, but so far have failed. Whether it was the dryness of the belt, or the combination of fastening studs in it, I cannot say.

London. **P. E. Davenport.**
March 26th, 1921.

City and Guilds Examinations.

Referring to my letter of January 31st, 1921 (which, so far, you have apparently not found space enough in your columns to publish), I should like to call your attention to the paragraph referring to the closing-down of City and Guilds Examinations in *all* technical subjects, except as regards the Final (Honours) Grade.

From my personal knowledge I know this cancellation has proved disastrous, as far as electrical classes are concerned, and apparently gas engineering and gas supply also.

The difference is, however, that "our friends the enemy" are not inclined to allow their business interests to be handicapped in this manner, and it is interesting to know that the result of their agitation is that the cancelled examinations have been reinstated in the subjects of gas engineering and gas supply.

If, Sir, this can be done by our gas competitors, surely our own Institution ought to be capable of similar action, on behalf of those who are so anxious to qualify in the branch of the industry they have entered.

It is important to note that these gas examinations will be held *next month*, and had my letter been brought to the notice of our profession, it is quite possible that pressure would have been brought to bear on the Board of Education, with the same satisfactory result as regards electrical examinations.

Of course it is impossible now, as far as this session is concerned, but I trust that some steps will be taken to ensure their reinstatement for the session 1921-1922.

It is quite beyond my comprehension to understand why such indifference is shown to educational matters, they being more generally pushed into the background, instead of being allowed to take their proper position in our profession.

Undoubtedly a well-educated body of workers is more contented and valuable to the general community than the reverse.

London. **Gus. C. Lundberg, M.I.E.E.**
March 22nd, 1921.

E

Wiring in Ferro-concrete Factories.

With reference to the correspondence that has appeared lately on the subject of wiring in concrete buildings, the letter of Mr. J. H. C. Brooking in your current issue raises a very important point regarding the right of users to criticise any material offered for sale. While I am not immediately concerned in the question of the merits or otherwise of cables for a certain class of work, I am in common with other engineers and users of electrical material very much concerned with the attitude taken up by Mr. Brooking, as it unfortunately represents the views of several of the large manufacturers at present. Mr. Brooking makes three suggestions as to how you should deal with letters similar to the one which has annoyed him, suggestions to which you will no doubt attach the value they deserve, but I think they should not pass unnoticed by your readers, especially the last one: That correspondents' letters should be submitted to the firms affected so that they could answer the *libellous* statements contained therein. While it may be the case that Mr. Brooking's firm deal satisfactorily with any complaints they may receive, this is not the case with a number of firms. Any engineer who has had to deal with firms regarding defective or unsuitable material knows the usual type of reply that is given in these cases—either an impossible "explanation" or an attempt at bluff, which is an insult to the complainant's intelligence. Mr. Brooking talks glibly about "libellous" statements as though every criticism of a manufacturer's products were libellous; no doubt there are certain firms who do make an honest effort to investigate users' complaints, and give help where it is required, but the point I wish to emphasise is that letters such as that written by Mr. Brooking are likely to do more harm to the industry than good, as it is really saying in effect to the user that So-and-So's manufactures are "IT," and you must not criticise. The technical Press should be open to all discussions on, and criticisms of, goods offered for sale; it is only by that means that results of use can be circulated, and really reliable information obtained. As one who has found the "Correspondence" columns of the REVIEW a mine of practical information during the past 17 years, I hope it will be a long time, if ever, before you adopt Mr. Brooking's suggestions.

Phase.

Synchronous Induction Motors and Power Factor.

In the *Electrical World* for November 20th, 1920, a very interesting series of tests carried out at the Yale University, U.S.A., on an ordinary induction motor, supplied with continuous current to the slip-rings, was published. Messrs. Warner and Knowlton, who carried out these tests, are to be congratulated on the intelligent way in which they have appreciated the difficulties which prevent supply engineers from doing anything on a large scale to improve the power factor of their stations, and on the manner in which they have in their paper expressed these difficulties; but unfortunately there is still a lot of valuable information which they have not given, and possibly cannot give.

Surely, Sir, here is an opportunity where some of our many British University and other laboratories might do something to help the supply engineers of our own country? For instance—

(1) The tests were only carried out on a 10-h.p. motor; how would they show up on a 100-h.p. motor, and with what result if the rotor were delta-wound?

(2) The constant excitation at which the tests were carried out, using only two limbs of the star, appears to have been fixed too low, apparently with the object either of improving the overall efficiency or of reducing the leading current at the lightest loads; but it is not made clear what is the exact load at which the motors become unstable, in regular running, with this particular current and with the *rotor* used as field.

(3) Similar information is wanted with respect to the load limits at synchronising; in other words, how much extra exciting current is required for additional load during this operation?

(4) What are the absolute limits to the exciting current which are fixed by the heating of the rotor windings?

It would surely well repay our Universities, &c., to ascertain further particulars regarding these, and many other, points of interest to supply engineers and to publish them.

A. M. Taylor,
Hon. Major, S.O.2, W.B.A.M.

Birmingham.
March 22nd, 1921.

Heating of Buried Cables Report.

I understand that in the discussion at Liverpool upon the above report, Mr. J. A. Morton referred to some results which I gave at Birmingham as to the relative heating with continuous currents and three-phase, 25-period, currents in the same bit of cable, and suggested that the results given, namely, a 50 per cent. sheath loss in the three-phase cable, as compared with the copper losses of the same cable when traversed by continuous current, in the experiments quoted by me, were incorrect and were due to the fact that a current of 400 amperes (d.c.) was passed through one core instead of a current of 230 amperes d.c. through each core.

I beg to say that Mr. Morton is wrong in his assumption, and that, as a matter of fact, experiments were tried in which 230 amperes d.c. was actually passed through each core and, so far from the temperature rise with direct currents coming out higher in this case, as Mr. Morton expected, the actual temperature rise was 12½ per cent. less.

The three-phase (25-periods) tests were, however, repeated later, and it was found that, instead of 50 per cent. loss in the sheathing and armouring, there was only 33 per cent. if compared with 400 amperes d.c. in a single core, but that there was 50 per cent. if compared with 230 amperes d.c. in three cores. The results given, therefore, substantially stand for 25 periods.

On the other hand, more recent experiments carried out at 50 periods showed that the losses were considerably less with 50 periods than with 25 periods, except in the case of single-phase currents.

Has Mr. Morton seen *La Revue Générale de l'Electricité* for August 7th, 1920, in which (I am told) Monsieur Capelville demonstrates, and quotes experiments to prove, that the loss in the lead sheathing converts into a drop in the copper conductor of 30 volts per mile? Now, the drop in the copper conductor due to a continuous current at 1,000 amperes per square inch would only be 50 volts per mile; therefore, according to M. Capelville, the loss in the copper due to a continuous current would be increased by 60 per cent., when traversed by an equal alternating current, due to the losses in the lead sheathing. This seems fully to bear out my contention, assuming that his experiments were made at 25 periods.

I believe I have the correct explanation of the losses (contrary to my expectation) being less with 50 periods than with 25 periods, but will not trespass upon your space at the present time to give my reasons. I may say, however, that I have tests to show that the losses with single-phase, 50-period, currents in armoured cables are greatly in excess of those with 25 periods.

As it is probable that in the near future we shall work with single-phase conductors and specially high voltages (see Clark and Shanklin's paper, Am.I.E.E.), the fact of the reduced lead sheath losses with three-phase cables at 50 periods will not help us very much.

A. M. Taylor,
Hon. Major.

Birmingham.
March 23rd, 1921.

LEGAL.

Walker v. Tipler and Another.

At Marylebone County Court on March 23rd, Judge Sir Walworth H. Roberts had before him a case in which Frank Walker (trading as Sowerbutts & Rodgers), of 122, High Street, Kilburn, electrical engineers, sued A. V. W. Tipler, a schoolmaster, of "Ballater," Harrow Road, Sudbury, and a Mr. Moseley for £29 8s. for supplying electric wiring to Mr. Tipler's house, including pendants, switches and fuses complete at £2 2s. per point, and also supplying a dozen Osram lamps at 3s. 6d. each.

The case for the plaintiff was that Mr. Moseley told Mr. Walker of the job, and he sent a man to make arrangements with Mr. Tipler to carry out the work of wiring. The work was done, and plaintiff sent the account to Mr. Moseley, who replied that the account ought to be forwarded to Mr. Tipler himself. This plaintiff did, but the money had not been found.

Plaintiff, in giving evidence, said in cross-examination that he would be surprised to hear that the account should not be paid until the question of commission was settled between him and Mr. Moseley.

Mr. Tipler, giving evidence, said that Mr. Moseley and he were in the Army together. Witness was mess officer and Mr. Moseley was sergeant cook. They became very friendly, and witness thought so well of the capable way he did his work that he lent him £70 to set up in business, and he was able to engage him at decorating his house. Witness obtained from the North Metropolitan Electrical Company an estimate which worked out at 35s. a point. Mr. Moseley told him he could get the work done at 30s. a point, and that was how he came into contact with the plaintiff. No estimate was submitted by the plaintiff, and he had never received an account from him of any kind.

It transpired in further evidence that the account had been paid with the moneys given by Mr. Tipler to Mr. Moseley, and his Honour gave judgment for Mr. Tipler and for the plaintiff against Mr. Moseley for the amount claimed.

Damage to Street Lamps.

At Whitehaven, last week, two youths named Samuel Skillen and Samuel George were fined 20s. each for wilful damage to electric street lamps. The town clerk told the magistrates that the total damage suffered last year amounted to nearly £400, and it was time an example was made of some culprits.

The damage done in the particular case under consideration amounted to £3 4s. 8d., the youths having thrown stones at the lamps.

OLDHAM, ASHTON & HYDE ELECTRIC TRAMWAY, LTD. v. CORPORATION OF ASHTON-UNDER-LYNE AND OTHERS. JUDGMENT.

THE Court of Appeal, consisting of Lords Justices Bankes, Warrington, and Atkin, on March 22nd, dismissed the appeal of the Oldham, Ashton & Hyde Electric Tramway Co. from the judgment of Mr. Justice Rowlatt on its appeal from the award of the arbitrator in the arbitration as to the purchase price to be paid to the appellant company by the Ashton and Hyde Corporations and the Audenshaw and Denton Urban District Councils.

The arbitrator awarded the company £142,000, and its case was that Mr. Justice Rowlatt ought not to have: (1) Depreciated the item as to engineering fees; (2) allowed nothing for the item as to the cost of raising capital; (3) should not have remitted to the arbitrator for reconsideration the item as to interest on capital during construction, and (4) that the learned judge should not have disallowed wholly the item with regard to the expenditure the company incurred in respect of the alterations to the Guide Bridge.

APPRENTICE FINED.

AT Bridlington, last week, an electrical apprentice named Major Dodgson (19) was fined 20s. for having connected a private wire to the Corporation electricity main. He admitted that he had done it against his employer's instructions.

BALLINROBE (CO. MAYO) ELECTRIC COMPANY.

MR. JUSTICE POWELL, in the King's Bench Division, Dublin, granted permission to the Ballinrobe (Co. Mayo) Electric Co. to enlarge its operations by the manufacture of woollens and textiles.

BUSINESS NOTES.

Bankruptcy Proceedings.—ALBERT LORD, 33, Westgate, Burnley, Lancashire, electrical contractor. The following are creditors:—

Electric Lamp Factors	£20	Metallic Electric Engineering Co.	£22
Greenhalgh	186	Royal Sovereign Lamp Works	15
Green & Co.	22	St. Helens Cable Co.	34
Hale, Kearn & Co.	20	Thornton, W. R.	131
Hasland Engineering Co.	31	Tucker, J. H., & Co.	42
Johnson & Phillips	80	Weyden Lamp Co.	68
Kippex, Wm.,	200	Whitaker, J., & Sons	11
Mason & Co.	15		

JOHN VINCENT BELL, 21, North Bar Within, Beverley, East Riding, Yorkshire, electrical engineer. The following are creditors herein:—

Briggs & Powell	£26	Siemens Bros. & Co., Ltd.	£80
General Electric Co., Ltd.	211	Ward & Goldstone, Ltd.	87
Pottage Bros.	11		

L. P. HOWSE and G. H. B. SNELL (HOWSE & SNELL), electrical engineers, 6 and 8, Duke Street, Margate.—Receiving order made March 21st, on debtors' own petition.

C. P. STANTON (Southern Electric Engineering Co.), electrical engineer, 25, Beckenham Grove, and 5, Laurel Grove, Penge.—Receiving order made March 22nd on debtor's own petition. First meeting April 4th at 132, York Road, Westminster, S.E. Public examination, April 21st, at the City Court, Croydon.

E. S. ELAM and J. WALTON (Elam Walton & Co.), electricians, 63, King Edward Street, Kingston-upon-Hull.—Last day for proofs for dividend, April 13th. Mr. G. H. Acheson, Official Receiver, trustee, York City Bank Chambers, Lowgate, Hull.

Company Liquidations.—IMPROVED SOLIDITE CO., LTD.—Mr. H. W. McLaren, of Buller, Viney & Co., of 68, Coleman Street, E.C., has been appointed receiver on behalf of the debenture holders.

STOLS ELECTROPHONE CO. (1914), LTD.—Winding-up order made March 22nd.

Our contemporary, *Electrical Industries*, asks us to state that it has no connection with a company entitled Electrical Industries, Ltd., a trading concern registered in May, 1920, and now in liquidation.

Dissolutions of Partnership.—SUNBEAM ELECTRIC CO., electrical factors, 63, Lancaster Avenue, Manchester.—Mr. A. E. Outhwaite and Mr. A. G. Hartley have dissolved partnership. Debts will be attended to by Mr. A. G. Hartley, who will continue the business.

J. A. FROST and J. W. FROST, electrical engineers, 70, Old Compton Street, W.—By order of the Westminster County Court, of February 18th, the partnership between Mr. J. A. Frost and Mr. J. W. Frost was dissolved as from May 22nd, 1920. Debts due to the said firm should be paid to Mr. J. A. Frost (the Receiver appointed by the Court) at 70, Old Compton Street, W.; particulars of debts owing should be sent to Mr. J. A. Frost by April 23rd.

Catalogues and Lists.—THE AUSTIN MOTOR CO., LTD., Longbridge Works, Northfield, Birmingham.—An illustrated and fully-detailed pamphlet dealing with the "Austin" 0·75-kW autoplant for country house lighting, &c. Also a similar pamphlet of the "Austin No. 4" lighting set.

MESSRS. PHILLIPS & TURNER, 115, Edmund Street, Birmingham.—Leaflet showing galleries, ceiling plates, &c., for electric light fittings.

MESSRS. GEO. M'CARTNEY & Co., Burnside Works, Cumnock, Scotland.—An illustrated and priced booklet of "Orb" switch and fuse gear of many types.

MESSRS. JONES & PORDES, 8, Crawford Passage, Farringdon Road, E.C. 1.—An illustrated and priced leaflet dealing with "Elba" dry cells, accumulators, portable bell sets, hand lamps, &c.

MESSRS. L. G. HAWKINS & Co., 116, Charing Cross Road, W.C. 2.—An illustrated and priced leaflet advertising the "Universal" electric washer.

MESSRS. BROTSCHI FRERES & CIE, S.A., Grenchen.—M. Leon Wulliman, of 4, Water Lane, Brixton Hill, S.W. 2, has sent us a leaflet relating to the screws, terminals and other such articles for the electrical industry made by this firm, which he represents here.

MESSRS. HERBERT MORRIS, LTD., Loughborough, Leicestershire.—List 301 Z, giving details of Morris electric hoist blocks, with illustrations of actual installations, as well as sizes and prices. Also two leaflets dealing respectively with steel joists, channels, angles, &c., and vertical boilers (made by H. Coltman & Sons).

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.—P Section (13th edition), an illustrated and fully detailed list of "G.E.C Witton" engine- and turbine-driven a.c. generators. The types shown are constructed to give supplies at 25, 40 and 50 cycles, and range from 30 to 1,000 kW.

THE GLOBE ENGINEERING CO., LTD., Perseverance Works, Huddersfield Road, Brighouse.—List No. 2. A leaflet giving illustrations and specification of small d.c. motors of 1 and 2 b.h.p.

MESSRS. EDWARD J. GOODWIN, LTD., 508, Mansion House Chambers, Queen Victoria Street, E.C. 4.—An illustrated booklet dealing with "Eastman" electrically-operated cloth-cutting machines.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Catalogue Section "J," an illustrated and priced booklet, giving full details of the "Simplex" colliery lighting system, describing many types of small junction or connector boxes.

Trade Announcements.—Messrs. Jones & Pordes announce that Mr. D. J. Esterson, of Glasgow, is not now representing them and that they have appointed MESSRS. MACDONALD AND SHAW, of 116, Hope Street, Glasgow, and MR. MASON ALCOCK, of Windsor Buildings, North Street, Belfast, and Dublin, to be their sole selling agents for Scotland and Ireland respectively.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed MR. C. H. SPAFFORD, 20, Falmouth Road, Bishopston, Bristol (who was with Messrs. Simplex Conduits, Ltd.), as their representative for the West of England; and MR. W. J. DAVIES, Dydraw, Porthcawl, as their representative for South Wales. His telephone number is "65 Porthcawl."

Messrs. McClure & Whitfield, of Stockport, have appointed the CITY ELECTRICAL CO., 1, Emerald Street, Theobald's Road, London, W.C. 1, their sole export selling agents, also their sole agents for the following districts:—London and the South-East Coast—1, Emerald Street, Theobald's Road, London, W.C. 1; Lincolnshire—High Street, Scunthorpe; the East Riding of Yorkshire—Jameson Street, Hull; the North-East Coast—67, Grey Street, Newcastle-upon-Tyne; South Wales—16, Charles Street, Cardiff.

MESSRS. J. CULKIN & Co., of Skinner Lane, Leeds, wish to receive catalogues, price lists, &c., of electrical goods, particularly motors, dynamos, switchgear, and power accessories.

THE TIVIDALE FOUNDRY AND ENGINEERING CO. have opened an office and saleroom at 2A, Merton Road, Watford, Herts., and they wish to receive catalogues and lists of electrical supplies.

Copper and Lead Prices.—MESSRS. F. SMITH & Co. report March 29th:—Copper (electrolytic) bars, £73, £2 increase; ditto sheets, £145, £2 increase; ditto wire rods, £89, £2 increase; ditto h.c. wire, 11¼d., ¼d. increase.

MESSRS. JAMES & SHAKESPEARE report March 29th:—Copper bars (best selected), sheets and rods, no change. English pig lead, £21 10s., 25s. increase on last week's price.

Australia and Trade with Germany.—Mr. Hughes, the Prime Minister, has confirmed a report that sales of wheat have been made to Germany, and has stated that the question of the resumption of general trade with Germany will shortly be submitted to Parliament.—*Reuter* (Sydney).

The G.E.C. Removal.—The new premises of the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C. 2, the erection of which was commenced some years ago, being subsequently held up by the war, will from Monday next, April 4th, become the head office, sales department and stores of the company. The new telephone number will be "Regent 7050" (50 lines). The goods entrance will be in Keeley Street. Until further notice the showrooms of the company will remain at 67, Queen Victoria Street, London, E.C. 4.

For Sale.—By direction of the Disposal Board, Messrs. Eadon & Lockwood will offer by auction on April 19th, 20th and 21st at the National Ordnance and Filling Factory, Chilwell, Notts., plant and machinery, including many electrical items; Messrs. King & King, on April 19th, at 46, Commercial Road, Portsmouth, will sell by auction machinery, electrical and other plant, &c.

Messrs. A. Dobell & Co. are offering by auction at Liverpool, on April 7th, a quantity of spruce deals and other timber, stored in Liverpool and Manchester. For further particulars see our advertisement pages to-day.

Book Notices.—"Employé Training." By J. V. L. Morris. Pp. xxiv + 312. Price 18s. "Connecting Induction Motors." By A. M. Dudley. Pp. xii + 252; 289 figs. Price 15s. London: McGraw-Hill Publishing Co., Ltd.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 3, March, 1921. New York: The Institute. Price $1.

"The Electrical Power Engineer." Vol. II, No. 9. March, 1921. London: E.P.E.A. Price 4d.—The present issue contains a portrait of Mr. J. F. Heslop, A.M.I.E.E., who is President of the Association for 1921. Reports of proceedings at various branches and a number of interesting notes also appear.

"Coil Ignition for Motor-Cars." By C. Sylvester. Pp. xii + 228; 106 figs. London: Sir I. Pitman & Sons. Price 10s. 6d. net.

"Artificial Light." By M. Luckiesh. Pp. xiv + 366; 41 illustrations. London: From the University of London Press, Ltd. Published by Hodder & Stoughton. Price 12s. 6d. net.

Fuel Research Board. Technical Paper, No. 2. "Report on the Simmance Total Heat-recording Calorimeter." By Thomas Gray, D.Sc., Ph.D., and Alfred Blackie, M.A. London: H.M. Stationery Office. Price 9d. (by post 10½d.)—This is the second paper in the series of Technical Papers of the Fuel Research Board of the Department of Scientific and Industrial Research. The report contains the record of the operations of the Simmance total heat-recording calorimeter for two periods. In the first of these the instrument was left to operate on town gas for five months with occasional adjustment, the readings of the recorder being compared with the results of determinations of the calorific value carried out with the calorimeter which forms part of the instrument. During the second period the instrument was supplied with mixtures of coal gas and water gas in order to check the accuracy of the gravity governor when subjected to rapid and extreme changes of density and calorific value. Tables and results of curves illustrating the experiments are also included.

"Electro-Deposition of Copper." By C. W. Danny. Pp. xii + 108; 29 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

Social Events.—Tredegars, Ltd.—On Tuesday, last week, an inaugural dinner was given to the staff of Messrs. Tredegars, Ltd., by Mr. Alex. Maclean and Mr. H. H. Millett, directors, at the Florence Restaurant, in honour of Mr. N. E. Bartlett, chairman and governing director. In proposing the toast of "The Queen and the rest of the Royal Family," the chairman, Mr. Maclean, said that the Queen had long been a most valued client of the firm and had visited Tredegars on several occasions. He then proposed "Tredegars," offering a most cordial welcome to the new head of the firm, Mr. Norman Bartlett. The business was founded by Sir Herbert Bartlett (who was present at the dinner) and was placed under Mr. Arthur Bartlett, whose loss they lamented; his brother had returned from the war and assumed the leadership. They were all out for success, and it was to their common interest to pull together with that object in view. Mr. Norman Bartlett, in responding, expressed his pleasure at meeting the staff under such happy auspices, and said that the company had established a reputation for good work, which they were all keen to maintain and increase. Co-operation won the war, and was the key to success in their joint purpose; with that in view, he asked for their help and friendship. Mr. Dudley Bartlett also briefly responded on behalf of Sir Herbert and the parent firm (Perry and Co. (Bow), Ltd.). Mr. H. H. Millett proposed the toast of "The Visitors, including the Press and the Artistes," and endorsed the chairman's remarks, adding that he hoped the dinner would become an annual event. Mr. Johnson responded. An excellent musical entertainment followed, the artistes being Misses Sybil Elliott, Jean Butt, Joan Bourset, Eva Scott-Thompson, and Nora Morris, and Messrs. W. K. Haselden and Morland Hay, who gave of their best to make the evening memorable.

The Scottish Electricians' Strike.—At a meeting of the Electrical Contractors' Association of Scotland, at Edinburgh, to consider the strike of electricians, it was stated that of the entire Scottish membership only two firms were reported as not having given notice of the reduction in wages. Their action, while affecting but a small number of employés, was strongly condemned as tending to prolong the strike. It was resolved to bring the names of the two firms before the Central Board of the Association for consideration. It was stated that men were beginning to come in and ask for work at the new rate. It was noted that some effort had been made by the Trade Union to call out selected men from firms affiliated to the Engineering Federation. In view of the fact that the standard rate of wages paid by that Federation was less than the rate now offered by the Electrical Contractors' Association, the employers' representatives at the meeting were of opinion that further immediate steps should be taken towards the equalisation of all wage rates of electricians in Scotland, and the introduction of one flat rate.

The men declare that they are resisting the wage reduction because it will mean the lowering of the level of subsistence for the workers not only in one, but in all occupations. It is pointed out that the result of the acceptance of lower wages in the electrical trade in Scotland will mean that the same will take place in England, where the employers are said to be awaiting the result of the dispute before putting forward reduction proposals on their own behalf.

The Industrial Situation in Austria.—Speaking on the trade results of 1920, and the prospects of 1921, at the yearly meeting of the Metal, Iron and Machine Trades Union of Austria, the president, Herr Hugo Noot, remarked on the severe struggle for existence which all the trades included in the Union had experienced in 1920. Hindrances on all sides were encountered. Heavy taxation had created wage disturbances. Austrian industries had withstood the test, but the almost unbearable tax burdens filled the future with forebodings. Passing the various trades in detailed review, that of water turbines had been fully employed. The lack of coal and petroleum had compelled, where possible, the development of unused water power for the generation of electric light and power. The electrotechnical trades, with a greatly lessened output, were comparatively busy. As in Austria only a small part of the production was consumed inland, outlets abroad had to be held and new ones opened; and there, especially in their old market, Czecho-Slovakia, the greatest customs obstacles were met with, notwithstanding that a great demand existed there, which the home industry was unable to satisfy. Efforts to supply the home demand were also observable in Poland, where a number of new factories had already been started. In Poland, Rumania and some parts of Jugo-Slavia, the Austrian industries had had to face foreign competition, especially German, French, Italian and English, which, on account of the currency obstacle, was very difficult to meet. With Bulgaria and Turkey, for political reasons, no effective trade relations were possible. Trade with Greece was only of small dimensions. Sales in the western lands fell through, owing to the lack of commercial relations. Extraordinarily burdensome to the electrotechnical industry were felt to be the transit limitations, and the export formalities which prevented the prompt forwarding of goods, the long storage of which represented a serious loss to all factories. Earnestly to be wished for were the regulation of traffic business, and a comprehensive reduction of the intolerable export formalities. The steady rise in wages and salaries, and the consequent increase in price of raw and half-wrought materials, the depreciation of the currency, the lack of raw and half-wrought materials which the electrotechnical industry had to procure from abroad, were bringing that industry into a daily worsening condition, leading to overstocking at home and the increase of the already formidable competition from abroad. Lack of coal lay at the root of Austria's industrial difficulties, affecting all her industries alike. The schemes to develop the country's water resources as a mitigation of this situation could not be carried out during the past year on account of the unexampled increase of building costs and the indisposition shown by foreign capitalists to adventure into such undoubtedly paying investments. The State Railway Department had drafted a big building programme, which the representative bodies had sanctioned, but its realisation was put off by the Finance Minister owing to lack of means, whereby their cost was still further increased. It was earnestly to be wished, in the interest of the popular welfare, that the greatest readiness should be shown in granting water-right concessions required for the furthering of home industries. Favourable concessions must likewise be granted to foreign capitalists, so that they might interest themselves in these businesses. In this matter, unfortunately, the existing provincial administrations had hitherto maintained a complete reserve, as they wished to develop the water resources themselves; but it was to be feared that for a considerable time they would be unable to command the needful means, and thus all efforts to benefit Austria's economic position would be frustrated. Sales of electric colliery and foundry machinery had not varied much from the total of the foregoing year. Investments in colliery property in the past half-year had occurred only in Poland, as the Polish Government had agreed to the free sale of coal in exchange for machinery equipment. As the delivery of such coal could only be made to Austria, considerable orders, as a result, had been secured by Austrian industries. No disposition for big investments had been shown in the Galician oil region. The Rumanian oilfields before the war placed the greatest part of their orders in Germany, and repairs and new orders for the most part had fallen again to that country's industries. There could be no doubt that the colliery and foundry industries had large orders to place, but these would not be issued until after the political and economic situation had become consolidated.

The New Customs Tariff in Spain.—The manufacturers of electrical material are protesting against the prolongation of the treaties of commerce. In order to avoid the retention for several months longer of the Customs surtaxes which came into force in November, the Government, it appears, has decided to negotiate with each country separately with a view to arranging partial exceptions to the present tariff in exchange for concessions to be made in favour of Spain regarding articles exported by her to the various countries.—*Reuter's Trade Service* (Madrid, March 20th).

South African Representation.—The Premier Engineering Co., of 4, Stella Buildings, Risik Street, Johannesburg, asks us to announce that it is open to represent makers of disk and rotary-type water meters, steam and crude oil engine generator sets, and steam wagons.

Motor-Car Batteries.—One of the latest products of Messrs. C. A. Vandervell & Co. is an entirely new battery which as its name, "C.A.V.-Willard," implies, has been produced as the result of an interchange of ideas between Messrs. C. A. V. & Co., and T. A. Willard, U.S.A.; instead of the usual grooved wood separators Willard threaded rubber separators have been adopted. Messrs. Vandervell have acquired the patent rights for Great Britain and the Colonies, with the exception of Canada, for the Willard rubber threaded separator and have undertaken to act as service representatives for the Willard Storage Battery Co., in this country. Mr. Irvin Kuhn, of the Willard organisation, has recently been in England consulting with the C. A. V. Co. on the new undertaking. The company is organising a complete chain of service stations throughout the country, and the organiser and manager of the C.A.V. service station scheme is Mr. George Gregory. The service is primarily intended to educate the car owner to appreciate the value and purpose of the battery, and by so doing create more battery satisfaction than has hitherto existed. Motor car manufacturers standardising "C.A.V.-Willard" batteries will supply with each car a battery registration card, upon which will be recorded every 14 days the condition of the battery during the 90 days' guarantee. Another feature of the scheme is a service station pass, in season ticket form, which enables the holder to obtain distilled water, testing, and advice free of charge at any of the company's service stations, which will carry stocks of new batteries and spare parts for repair work, also batteries which can be hired out to users at a standard uniform rate throughout the country. The scheme is planned to be everywhere operated by entirely independent traders in preference to branch premises owned and staffed by the company, so as to give greater value to the user, inasmuch as the service trader is in a position to regard all transactions from an entirely independent and different view-point from that of the manufacturer, consequently in the wider application of business he possesses that freedom of action which secures the confidence of the customer in his purchases. *Motor Commerce* also announces that Mr. S. W. Windeler, of the Mack Storage Battery Co., Toronto, Canada, is now in this country for the purpose of placing "Mack" batteries on the English market, and at the request of Sales, Ltd., will take care of the sales side of the business. A company is being formed and it has been decided to manufacture a full range of all types of batteries, including those for motor car starting and lighting. *Motor Commerce* states that its representative has witnessed interesting demonstrations of the abuse that the "Mack" battery will withstand without adverse effect, among them being welding together 6 in. iron nails, and melting steel files by connecting them across heavy cables connected to the battery terminals. In another instance, a heavy car was towed by a much smaller vehicle driven by the standard starting motor, the current for which was supplied by a Mack battery, 140 yards being covered before the battery was totally discharged. A final test was to place a Mack battery on a charging bench, giving it a reverse charge at 10 amperes for 12 hours, the charge afterwards being made in the right direction. Such abuse far exceeds the average ill-treatment a battery receives in actual practice, yet the battery was opened afterwards for inspection with two cells in a charged condition and the other cell in a discharged state, and the plates were found to be in excellent condition.

Cancellation of Orders in the United States.—According to a statement issued on March 8th by the Fabricated Production Department of the Chamber of Commerce of the United States, cancellation of contracts is one of the contributory causes for the present slump in business. This conclusion was reached by the Department after a six months' study of the cancellation evil. The influence of early repudiation of orders, it is pointed out, spread rapidly, and brought about a creeping paralysis of industry. In a number of lines, partly because of cancellations, plants were reduced from overtime production schedule to three days a week, and in some instances, to a complete shut-down. Legal remedies have been of little avail, for the ailment has shaken confidence, confidence, which must be restored before better times can be looked for. The investigation of cancellations showed that there were plenty of cancellations mutually arranged which were beneficial to both parties, but there were many others which caused hardship to either the buyer or the seller. Of the latter type, the number of sellers who violated their contracts were about equal to the number of buyers who cancelled orders. The investigation also disclosed that a large number of business men bore losses rather than repudiate contracts.—*Reuter's Trade Service* (Washington).

Chilian Copper Production.—There is to be a radical curtailment of operation in some of the large copper mines of Chile. The output of one mine will be reduced from 3,000 to 1,000 tons per month, and other companies will also greatly restrict production. These mining camps absorb a large quantity of American products, and their partial suspension, pending recovery of the copper business, will further restrict Chile's imports from the United States.—*Reuter's Trade Service.*

E.D.A. Activities.—The British Electrical Development Association, Hampden House, Kingsway, W.C. 2, has just issued a pamphlet exhorting its readers to "Use the electric vacuum sweeper, and you will not fear the sunshine," and extolling this method of "spring cleaning."

Trade with Denmark.—The extended application of electric power in Denmark is hindered by circumstances over which that country has little control. Its territory is flat and possesses no sources of cheap water power which might be utilised for the generation of electricity. Equally important in its bearing on this matter is the fact that Denmark has to import all her supplies of coal. It is stated that for her import of some 2,400,000 tons of coal, coke and briquettes in 1919, Denmark had to pay between 100 and 500 million kroner, compared with the 60 or 70 million kroner which she spent previously on an import of 3,600,000 tons. (This partly explains why the coal miner is about the only worker who can afford Danish butter.) Electricity's future in Denmark is linked with the import of energy from Norway or Sweden, where spare hydraulic power is available. Plans are in progress for an extension of this source of supply to Denmark.

Proposed Tour of Danish Engineers.—It was reported recently in Copenhagen that a party of electrical engineers proposed visiting the United Kingdom with a view to an inspection of the latest practice in electricity production and electrical manufacture. Such visits were formerly paid to Germany. No doubt Danish engineers in such a tour would see a great deal to incline them to add to their connections with our manufacturers. In the opinion of H.M. Commercial Secretary at Copenhagen, under normal conditions there should be a market in Denmark for practically all classes of British goods, and that even if there is at present little prospect of immediate business, British firms should not lose touch with their Danish connections. On the whole, the Danish market may be said to be readily receptive of British goods as regards style and quality, and provided British exporters pay attention to the requirements of the market, and, where possible, visit the country from time to time to become personally acquainted with their agents and their customers, there would appear to be no reason why a considerable share of Danish imports of manufactured goods should not come from the United Kingdom. For the present, however, British exporters of commodities which come under the category of articles of luxury should not expect any considerable trade.

On the whole the Danish metal industry was well employed during 1919, and the number of hands engaged was considerably increased. Certain branches of the industry suffered not a little from foreign competition, and particularly from Germany. The electrical industry was busily engaged during the year, as there was a considerable shortage of lighting material, which led to a general desire to introduce electric plant. The number of employés in the installation industry rose from 2,500 to 3,200 during 1919, and could have been increased further had sufficient trained labour been available.

Forthcoming Exhibitions.—The following exhibitions are being organised :—

London.—April 1st to 30th, Building Trades' Exhibition; April 30th to May 14th, Printing, Stationery and Allied Trades' Exhibition; June 3rd to 17th, Rubber Trades' Exhibition; July 4th to 15th, London Fair and Market; September 7th to 28th, Shipping Engineering, and Machinery Exhibition; October, Society of Motor Manufacturers and Traders; November 17th to 25th, Public Works, Roads, and Transport Exhibition. 1923—British Empire Exhibition.

British Dominions.—June, 1921, Dominions Touring Exhibition (*South Africa, Canada, Australia, and New Zealand*).

France.—(*Bordeaux*) June 15th to 30th, International Samples Exhibition.

Belgium.—(*Brussels*) April 4th to 20th, International Commercial Fair. (*Ghent*) April 16th to June 14th, International Exhibition of Architecture, Building, and Kindred Industries.

Switzerland.—(*Basle*) April 16th to 26th, Swiss Industries Fair; May 28th to June 8th, International Automobile Exhibition.

Holland.—(*Utrecht*) September 6th to 16th, International Fair.

Italy.—(*Milan*) April 12th to 27th, International General Manufacturers' Fair.

Spain.—(*Barcelona*) April 1st to 10th, International Samples Fair.

Iceland.—(*Reykjavik*) June, World's Fair.

Peru.—(*Lima*) June 1st to October 31st, International Industrial Exhibition.

Argentina.—(*Buenos Aires*) 1922, International Exhibition.

Brazil.—(*Rio de Janeiro*), 1922, International Centenary Exhibition.

Mexico.—September, Commercial and Industrial Fair.

Java.—(*Bandoeng*) September 19th to October 9th, Netherlands East Indies Fair.

Czecho Slovakia.—(*Prague*) May 28th to June 5th, Automobile Exhibition. (*Reichenberg*), August 13th to 21st, International Fair.

Poland.—(*Warsaw*) May, Building and Fire Protection Exhibition.

Institute of Cost and Works Accountants.—Miss M. S. Neale, chief cost accountant to Messrs. Allen & Hanbury, Ltd., of Bethnal Green, E., has been admitted as a "Fellow" of the Institute of Cost and Works Accountants. The next examinations of the Institute will be held during the first week in June in London, Birmingham, Manchester, Glasgow, Sheffield, and Bristol. Forms of application and full particulars may be obtained from the Secretary at 30, Grosvenor Gardens, S.W. 1.

German Reparation (Recovery) Act: Committee Appointed.—Under Sec. 5 of this Act, which takes effect on Thursday, March 31st, the Board of Trade may by order take certain action, as indicated below :—

(*a*) Under Sec. 1 of the Act, importers of German goods are to pay to the Customs a prescribed proportion of the value of the goods, not exceeding 50 per cent. The Board of Trade may reduce the prescribed proportion as respects articles of any class, make or description, or may exempt such articles from all the provisions of the Act.

(*b*) Sec. 2 excludes from the provisions of the Act goods partially manufactured or produced in Germany which are not first consigned from that country, and in which 25 per cent. or more of their value is attributable to processes of manufacture undergone since they last left Germany. The Board of Trade may vary this percentage as respects articles of any class, make, or description.

(*c*) Under Sec. 1 the Act shall not apply to goods imported before April 15th, if it is proved to the satisfaction of the Customs that the goods are imported in pursuance of a contract entered into before March 8th. The Board may, as respects articles of any make, class, or description, substitute some later date for April 15th.

(*d*) Sec. 4 provides that where any person is liable, under a contract entered into before March 8th, to accept bills of exchange or make advances in connection with the importation of any goods, he may apply to the High Court; and the Court, if satisfied that by reason of the provisions of this Act, the enforcement of the contract would result in serious hardship to him, may suspend or annul, or with the consent of the parties amend the contract as from such date as the Court may think fit, or stay any proceedings for the enforcement of the contract or any term thereof, or any rights arising under it, on such conditions (if any) as the Court may think fit. The Board of Trade may extend the classes of contract to which the Section relates.

The Board is not, however, to make any order under any of the above provisions except on the recommendation of a Committee which it is to appoint, consisting mainly of persons of financial, commercial, or industrial experience.

The following Committee has accordingly been appointed by the Board of Trade, under Sec. 5 of the Act :—

Mr. H. A. Trotter, Deputy Governor of the Bank of England (chairman).

Mr. H. B. Betterton, M.P., C.B.E.

Mr. F. R. Davenport, managing director of Messrs. Willans and Robinson, Ltd., Rugby.

Mr. Stanley Machin, President of the London Chamber of Commerce.

Mr. D. Withers, manager, Foreign Branch, London County, Westminster, and Parr's Bank.

Captain G. W. Duncan (secretary).

Applications to the Board of Trade to make any order under any of the provisions referred to should be addressed to the Secretary, Board of Trade, Great George Street, Westminster, and both the letter and envelope should be marked "German Reparation."

Wages Reduction in Sweden.—The L.M. Ericsson Telephone Co. has reduced the wages of its staff by 10 per cent. with a view to enabling the company to compete with foreign manufacturers.—*Reuter's Trade Service* (Stockholm).

Italian Industrial Revival.—The mechanical industry throughout Italy is showing sustained evidence of revival, the iron, shipbuilding and mechanical workshops at such centres as Genoa, Savona, Terni, Naples, Sampierdarena, Pozzuoli, &c., having already almost attained pre-war activity. A surprisingly rapid transformation from the production of war material to the supplying of many needs was made some months ago, and, but for the political unrest, the majority of the factories would have been in full operation ere now. Equipment, indeed, has increased in some instances faster than the supply of skilled labour, while wages have risen until a first-class mechanic now asks as much as 20 and 22 lire per diem. Before the war the rate was seldom above 10 lire. The most important engineering products now being turned out are railway material and agricultural implements. If Italy succeeds in maintaining a steady flow of raw materials (and some substantial contracts have been made abroad of late in this direction), the majority of the iron and steelworks in the districts mentioned should soon be in full operation. Steel is particularly in request, a large number of cars having been compulsorily laid aside in certain of the shops, owing to the lack of steel for the frames. Wherever possible, wood has been substituted for steel; but even the requisite lumber is wanting in sufficient quantities. Owing to the lack of coal, some of the larger establishments during the war installed electrically-driven machinery, and this is being found very serviceable to-day. Steam plant is being retained as a standby for periods of breakdown or increased demand. Notwithstanding the difficulties created by the exchange situation, several large orders are being placed by Italian factories for new machinery, such as hydraulic presses, foundry equipment, textile machinery, and general labour-saving devices.—*Reuter's Trade Service* (Savona).

The A.E.G. in Luxemburg.—The Société Luxembourgeoise pour Entreprises Electriques has been formed at Luxemburg, with a share capital of 3,000,000 fr., divided into 6,000 shares of 500 fr., of which the A.E.G. has subscribed 5,944 shares.

Prices Reduced.—Substantial reductions in the price of the "Electrolux" suction cleaner are announced by the Z Electric Lamp and Supplies Co., Ltd., owing to increased demand and increased production leading to reduced cost.

Electricity District Schemes.—When a scheme for improving the organisation of electricity supply in a district has been submitted to the Electricity Commissioners, it has to be put on sale by the promoters and thus made accessible to the public. The London County Council is now advertising the scheme and technical report prepared under its auspices. Particulars of the publishers and prices of other schemes that we have reviewed have been given in each case in connection with our abstracts.

A Belgian Dividend.—The Ateliers des Constructions Electriques de Charleroi propose to pay a total amount of 87.50 fr. per share on the ordinary shares, comprising arrears of dividend for the past seven years, including 1914.

Inquiries.—The names and addresses of makers of "Sun" bonding pliers, and "Puralite" fittings No. F. 56, are asked for.

The Bitterfeld Chemical Works.—The undertaking of the Electrochemical Works Co., of Bitterfeld-Rheinfelden, whose shares are held by the Berlin Electricity Works Co. and the Zurich Bank for Electrical Undertakings, has been sold to the German aniline dye group, represented by the Griesheim-Elektron Chemical Works Co., which has held a lease of most of the plant for a number of years. The works were originally started in 1893 by Herr Walter Rathenau, and the value of the present transaction is estimated at over 100,000,000 marks.

LIGHTING AND POWER NOTES.

Aberdeen.—Details of Proposed Extensions.—In our last issue we announced that the Town Council had under consideration extensions to the Ferryhill electricity works, estimated to cost £210,540. This amount is made up of the following items :—A 10,000-kW, 6,600-V, 50-cycle turbo-alternator, with condenser, pumps, foundations, &c., £77,000; two 36,000-lb. boilers, with superheaters, economisers, forced and induced draught apparatus, steel chimney, boiler-house building, foundations, piping, valves, &c., £60,000; engine-room and switch-room extensions, £20,000; one 1,500-kW and one 1,000-kW motor converters, £18,000; e.h.p. and l.p. switchgear, £10 000; one 60-ton electrically-driven crane for the engine room, £6,400; contingencies (10 per cent.), £19,140. The expenditure would be spread over a period of two years. In a recently-presented report the electrical engineer (Mr. J. Alex. Bell) justifies this outlay by giving details of the rapid development and the remunerative nature of the municipal undertaking.

Aylesbury.—Loan Sanctioned.—The Town Council has received sanction to a loan of £6,074 for electricity purposes connected with the housing scheme.

Ayr.—New Plant Proposed.—At a meeting of the Town Council, there was submitted for approval a draft agreement with Kilmarnock for the supply of electricity in bulk by that authority to Ayr. The agreement was severely criticised, and it was stated by members that a supply from Kilmarnock would involve a heavy cost, although the Town Council would have very little to say in the matter. It was eventually decided that the member of Parliament for Ayr Burghs should be asked to urge the Electricity Commissioners to permit the purchase and installation of a 1,500-kW turbo-generator, for which accommodation already exists at the Council's station.

Bedford.—Price Reduction.—The Town Council has decided to reduce the charges for electricity for lighting from the next quarterly readings of the meters from 10d., less 2½ per cent., to 9½d., less ½d. per unit; and for power by ½d. per unit.

Belfast.—Protest against Award of Contract.—The Secretary of the Belfast Builders' Association has written to each member of the Corporation protesting against the action of the Electricity Committee in recommending the awarding of the contract for the Harbour power station to a certain firm, as it is maintained that the prices tendered by members of the Association were considerably below those specified in the recommended tender. The reasons given by the Committee for its refusal to accept the tenders of Association firms were that members of the Association refused to accept the city surveyor's conditions of contract, and that their tenders were based on a proposed wage increase, allowing for fluctuations. The recommended tender was based on existing wage rates. The Secretary of the Association states that responsible members of the Association tendered at figures about £12,000 below the figure recommended for acceptance by the Committee, and even when the tenders of members of the Association were adjusted to the basis on which the recommended tender was calculated they were still £5,000 below it. The secretary asks, therefore, that consideration of the tenders may be postponed until the wages question is settled when fresh tenders could be invited and given on a fresh basis.

Extensions.—At a special meeting of the Corporation Electricity Committee a report was received relative to the interview which Councillor O. Jamison, Councillor W. Addis, and Councillor T. E. M'Connell, J.P., and the city electrical engineer had with consultants in London regarding the installation of the second 6,000-kW set temporarily at the auxiliary power station at Musgrave Channel Road and the provision of the

necessary converting plant at the East Bridge station. Already the Council had sanctioned £24,000 for this purpose, but an additional £14,000 was required. The Committee decided to recommend the Council to approve of this expenditure.

Canada. — Hydro-electric Extensions in Manitoba.—The Manitoba Provincial Government proposes to expend a million dollars on the extension of hydro-electric power mains to rural points during this year.—*Reuter's Trade Service* (Winnipeg).

Ceylon. — Hydro-electric Developments. — The Government of Ceylon has approved the recommendations of Mr. J. W. Meares, electrical adviser to the Indian Government, relative to the development of the Laxapana-Aberdeen hydro-electric scheme, and has ordered detailed surveys to be made. The scheme advocated involves diverting by canals the waters of the Kehelgomu Oya and the Maskeli Oya above their junction to a point where an effective head of approximately 2,000 ft. can be obtained. The scheme also involves building storage reservoirs to equalise the flow. The consumers of the power would be the hill country, the Colombo suburban railways, the towns of Colombo and Kandy, tea and other factories, sewage-treatment works, and water-pumping plant for city flushing. As there is not at present sufficient demand for the full 100,000 h.p. which will become available, it is proposed to make an initial development of only 24,000 h.p., leaving future extensions to be performed in three additional developments as the demand for power increases. When the detailed survey is completed, the plans and estimates will be forwarded by the Local Government to the consulting engineer in England, who will draw up conditions of contract and call for tenders.—*Commerce Reports.*

Chester.—Power from the River Dee.—The Board of Trade has inquired of the Electricity Committee whether the Corporation has any reasons to advance why the Board should not now ask for the early removal of the curb from the weir on the river Dee. Instructions were given for the town clerk to explain that the removal of the curb would mean a reduction in the amount of electricity generated, and a consequent reduction in the supplies to industries, many of which already were curtailed considerably, and that such a reduction could not be made good by the steam station, which was already overtaxed, and permission to extend could not be obtained.

Finance.—The city accountant has reported on the expectations of the Electricity Committee. Last year, he stated, there was a net profit of only £164, this year a net profit of £3,873 was expected. There was a probable increase in the charges for light and power, although one increase was made last year. He was told that an increase was likely by reason of the Committee having applied revenue for capital charges, necessitating an overdraft at the bank of about £7,000. The present charge of 5d. was not high, and the average charge for 82 county boroughs was 7d. The tramways had had a bad year on account of the high charges for materials, high wages, and the cost of the permanent way. There was no balance available for transfer to the reserve fund.

Continental.—Switzerland.—The special correspondent at Vevey of the *Daily Mail* gives some details of the effects of the prolonged drought upon the hydro electric works and connected industries which play such a prominent part in the economic life of modern Switzerland. The large station at Muhleberg, near Berne, which normally produces about 64,000 h.p., was for a time able to supply only 5,000 h.p. The effect of the loss of power upon industry was counteracted to a great extent by the existing trade depression.

Dundee.—Temporary Stoppage.—An exceptionally low tide in the estuary of the river Tay led to an hour's suspension of the supply of electricity on March 23rd. The water required at the station at Carolina Port is drawn from the river by means of a large pipe, the water gaining entrance to the pipe *via* a screened dam. On Wednesday the water receded so far that only a very small portion of the screen was submerged, and a quantity of silt gathered at the bottom of the screen, with the result that water in sufficient quantity could not force a passage ; the condenser vacuum was lost, and the turbines stopped running.

Dutch East Indies.—Electrical Developments.—There are indications of a great development in the generation and use of electricity throughout the Dutch East Indies. Extensive investigations are being made into the water power of the various rivers with a view to the electrification of the railway and tramway systems. Housing and building schemes in all the large towns and seaports in Java and Sumatra call for supplies of electrical apparatus of various types.—*Reuter's Trade Service* (Bombay).

Electricity District.—North-West Midlands.—The Electricity Commissioners give notice that the time within which objections and representations may be made, and schemes submitted in connection with the above-named district, has been further extended from the last day of March until July 30th, 1921.

Hastings. — Plant Extensions. — The Town Council has approved a scheme for extending the electrical plant, at an estimated cost of £51,429. The extensions have been rendered necessary by the great increase in the number of consumers.

India.—Punjab Developments.—The development of schemes for electrical power in the chief centres of the Punjab has lately made considerable progress. Lahore and Amritsar are already provided with electricity, and arrangements are in train for supplying electricity to Rawalpindi, Multan, and Lyallpur.—*Indian Engineering.*

Isle of Man.—Electric Light for Douglas.—In the Legislative Council, on March 8th, the Douglas Corporation Electric Light and Power Bill was read a second time, and the Committee stage of the Bill postponed in order that several amendments suggested by the Postmaster-General, the Manx Electric Railway Co., the Douglas Gas Co., and the original promoters of the Electric Light Bill might be circulated.—*Isle of Man Times.*

Kilrush (Co. Clare).—Electric Lighting.—The Urban Council has decided to ask Messrs. Glynn, owners of an electrical plant with surplus power, to undertake the lighting of the town at a price to be fixed. A member stated that the cost would be about £2,000 or £3,000—or one-half what an outside company would charge.

Mansfield.—Price Increase.—The Town Council has decided to increase the charge for electricity to 10d. per unit, as from the end of the March quarter. The pre-war charge was 4d. per unit.

Newark.—Electricity Scheme.—The Town Council determined, at its meeting on March 21st, to proceed, at an estimated cost of £100,000, with a new scheme of electricity supply. Mr. Wordingham had prepared a project for the establishment of a 1,500-kW plant, with a stand-by plant of similar capacity, it being recommended that, in the event of a provisional order being obtained, his services should be secured to carry out the work. An amendment, which was defeated, was moved in favour of delay and further consideration of the matter by the Committee. Alderman Patrick urged that the Council should not delay any longer a scheme which already had been under discussion for 20 years, and that view was generally acquiesced in, the chairman of the Committee (Alderman Priestley) explaining that it was proposed to deal with Newark and the rural district, and if the East Midland authority was unable to supply Southwell and Warnsfield, to include those places also, together with others *en route*. To ensure a reliable supply, the plant should be duplicated, and with 3,000-kW capacity available they could produce 4,000,000 units per annum. The estimated cost of buildings to house the machinery was £55,000. The average cost per unit would work out at 2·29d.

New Zealand. — Ashburton County Electrical Scheme.—An electrical scheme for the County, at an estimated cost of £230,000, has been decided upon. The plans provide for the distribution of electricity throughout Ashburton County, serving an estimated total of 2,500 consumers, from a supply at 11,000 volts taken in at two points—Ashburton and Methven. The scheme will be entirely self-supporting, the estimate allowing a loss of approximately £2,000 upon the first year's operations. It also provides for the purchase by the proposed Power Board of the plant of the Ashburton Electric Supply Co. Arrangements have been made for the presentation of a petition to the Government asking that a power district be created. The Public Works Department will also be asked to set aside 700 kW from the sixth set at Lake Coleridge for the use of the county.—*Reuter's Trade Service* (Melbourne).

Oldham.—No New Mains.—The Corporation Electricity Committee has decided that for the present new supplies shall only be given along the routes of existing mains, owing to the prohibitive cost of new mains. Similar action has been taken at Blackpool.

Salvador.—Electric Light Company Authorised.—The municipality of Santiago de Maria, Department of Usulutan, has granted a contract for the establishment of an electric light company, which is to furnish light to that city and also to the city of Berlin, in the same department. The United States Vice-Consul there estimates the populations of the two cities at 10,000 and 9,000 inhabitants respectively.—*Commerce Reports.*

St. Helens.—Maximum Charges.—On March 22nd the St. Helens Corporation Bill was again considered by the Local Legislation Committee of the House of Commons. One clause of the Bill was to confer upon the Corporation powers to increase the maximum charges for electricity, and the borough electrical engineer gave evidence in support of this clause. Eventually the Committee decided that the clause should be altered as the Minister of Transport was the appropriate authority to sanction such increases.

Stoke-on-Trent.—Land for Sub-Station.—In response to an application by the Corporation for permission to borrow £2,467 for the purchase of a site for a new sub-station, the Electricity Commissioners have written asking the Corporation to apply in the first place for sanction to hold more than five acres for electricity purposes. This is being acceded to.

Tamworth. — Proposed Mains Extensions. — The Midland Electric Light and Power Co. has applied for an order to lay cables in the parishes of Amington, Bolehall, Glascote, Shuttington, and Wilnecote.

Torquay.—An Alternative Scheme.—Following upon the decision of the Town Council to delay further action with regard to the erection of the proposed station at Newton Abbot, on account of the expense involved, a syndicate has placed before the Electricity Committee another scheme which it is claimed will prove more advantageous and cheaper in first cost. This syndicate is about to engage in the production of oil from the lignite beds of the district, and works are to be erected at Heathfield for this

purpose. It is stated that a large amount of surplus power will be available, and the syndicate offers to transmit this in bulk to the Corporation's present station, or to a station erected for the purpose. The cost of the necessary cables will be between 50 and 70 thousand pounds. The Council is making further investigations into the matter.

United States.—Large New York Station.—The *Electrical Review*, of Chicago, states that the United Electric Light and Power Co., New York City, has under construction a new generating plant known as the Hell Gate station. This station, when completed, will be one of the largest generating stations in the world, with a rated capacity of 280,000 kW. The foundations, water-front improvements, &c., are now well under way, and steel erection is about to begin. The plant will be unique in many respects. The turbine room will be parallel and adjacent to the river, so that it will be possible to eliminate the suction tunnel, individual suction pipes being carried through the east foundation wall into the screen basins behind the bulkhead line. The boiler house will be next to the turbine room, between the electrical galleries and the turbine room, and will be separated from the electrical galleries by a narrow passage. The initial installation of generating equipment will consist of two 35,000-kW 25-cycle, three-phase, 11,000-volt General Electric turbo-generators and two 35,000-kW, 60-cycle, three-phase, 15,200-volt Westinghouse turbo-generators.

Waterford.—Extensions Postponed.—The Corporation has decided to postpone consideration of the proposed extension of the city electric lighting, pending the receipt of estimates, &c., as to the lighting of the Ferrybank district.

Watford.—Price Increase.—The Urban District Council has increased the charge for electricity supplied through slot meters from 5½d. to 8d. per unit.

Woking.—Inquiry.—An inquiry was held on March 22nd relative to the application of the Electric Supply Co., Ltd., for power to increase the maximum charge for electricity from 9d. to 1s. 2d. per unit. The application was opposed by the Urban District Council, and it was stated by the company that it was intended to charge only 10d. per unit, unless circumstances rendered it necessary, but the Council declined to agree to this.

York.—Electricity for Sewage Works.—At a meeting of the Flaxton Rural District Council, near York, last week, it was decided to authorise the installation of electric power at the Strensall sewage works, and an agreement with the York Corporation is to be entered into. At present the power is provided by oil engines.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—Opposition to Order.—The Caledonian, North British, and the Great Northern of Scotland Railway Companies have lodged a petition of protest against certain clauses in the Aberdeen Corporation Provisional Order which seeks, *inter alia*, to obtain powers for the Corporation to construct a railway from Market Street to the electricity works.

Blackpool.—Proposed Fare Increase.—The Corporation is endeavouring to obtain powers to increase the tramway fares. The profits on the undertaking have dropped from £30,000 a few years ago, to barely £5,000.

Continental.—France.—The work of electrifying certain French railroads, which started in 1920, has made rapid progress. The Midi Co. has 150 km of double-track electric line in operation, and the work of electrifying 3,000 km. in addition is actually in progress. The reconstruction of two hydro-electric plants, which will furnish 150,000 h.p. each to this road, is nearly completed. The road has placed orders for 50 new electric locomotives of the type used by the Chicago, Milwaukee, and St. Paul Railway. Two other French railroads have undertaken the electrification of sections of their lines—the Orléans, which is electrifying 3,000 km., and the "P.L.M.," which is electrifying the same extent of track. The power for the Orléans road will be furnished by the waterfalls of the Upper Dordogne, and that for the "P.L.M." by the falls of the French Alps. The cost of electrifying these railroads will be in the neighbourhood of 5,000,000,000 fr. The saving in coal will exceed 3,200,000 tons per annum, which, supposing the price of coal per ton to be above or equal to 100 fr., will, at the current rate at which money may be borrowed in France for such work, more than pay the interest on electrification bonds issued.—*Electrical World.*

Paris Municipal Council has decided that women tramcar conductors are to go, though an endeavour will be made to find employment in the depôts for such of them as wish to remain in the tramway service.—*The Times.*

Exeter.—Proposed Sale of Undertaking.—In view of heavy losses incurred by the Corporation tramway undertaking, the City Council, at a meeting on March 22nd, discussed future proposals. It was suggested that the service should be greatly restricted, or that the tramways should be given up, or that the whole business should be sold to a company. The decision is to be made at a later meeting. Provision is made in the coming year for an estimated loss of £4,000. The Tramway Committee attributes the position to advances in wages and the high cost of materials. It was stated that the tramway staff was discontented. Pending a final determination as to the future of the tramways, approval has been given by the Council to the sale of surplus stores, amounting to £1,320.

Keighley.—Increased Charge for Power.—The Electricity Committee has recommend that the price of electricity supplied to the tramway department be increased to a flat rate of 1·75d. per unit. The present charge is 1·5d. per unit for the first 250,000 units, and 1d. per unit above this amount. The increased charge, it is recommended, should be placed in force upon April 1st, and retained for a period of one year.

London.—Extension of Suburban Services.—The London County Council has completed the track on Eltham Road, Lee, and in a few days' time will extend service 46—Southwark Bridge and Eltham—to Beresford Square, Woolwich. This will afford at least three advantages:—A through route from Beresford Square to Lewisham, a quicker route from Shooter's Hill to Lewisham (by avoiding the journey *via* Woolwich Road), an alternative route, for the major part rural, from Bereford Square to Forest Hill, Catford or Beckenham Lane by a change at Lewisham Obelisk. The new tramway will serve the housing estate of the Woolwich Borough Council as well as the older portion of Eltham, where some property has been pulled down and the road widened. —*Kentish Mercury.*

Train Mishap.—On March 28th, as a train left the Farringdon Street Station of the Metropolitan Railway, a sudden access of speed caused some couplings in the middle of the train to break. The rear carriages remained in the station, and the front portion of the train proceeded some distance before it could be stopped. The passengers were transferred to other coaches.

Leyton.—Proposal to L.C.C.—In the hope of turning losses into profits, the Leyton (Essex) Council is asking the London County Council to take over its tramway system under a partnership scheme for 10 years.—*Daily Mail.*

Liverpool.—Report on Accident.—Major A. Mount, R.E., has presented a report to the Ministry of Transport upon an accident which occurred at the James Street Station on the Liverpool Overhead Railway, on January 25th. Two electric trains were involved; one was standing at a platform when the other ran into its rear, causing shock and minor injuries to about 37 persons. The inspector states that this was a simple, but serious, case of misunderstanding and slack working under normal conditions, and he is satisfied that the signals and block instruments concerned were in working order. It appears that a ticket collector, who was responsible for the block instruments, displayed a green light, stating that he took the starting signal to be "off." After the train had proceeded, he discovered that the James Street section was blocked. He tried to rectify his mistake by telephone, but the collision occurred almost immediately. The driver of the second train said that he noticed both the collector's green light and also that the starting signal was at "danger." He took the collector's signal to mean that the fixed signal was out of order, and so proceeded. This was against a definite rule on the subject of defective signals, and Major Mount, therefore, lays the blame equally on the collector and the driver. It is recommended that the practice of hand-signalling all non-stop trains should be discontinued, as it is misleading. The inspector also recommends the abolition of cut-out switches in cabs, and the installation of louder bells on the block telephones.

Railway Fusion.—L. & N.W. & Lancs. & Yorks. Companies.—A provisional agreement has recently been entered into for the acquisition of the Lancashire and Yorkshire Railway Co. by the London and North-Western Railway Co. The "London and North-Western" title will cover both systems, which will be governed by one board of directors. The L. & N.W. Co.'s mileage is 2,338, and the L. & Y. Co. operates 2,262 miles of line.

Wolverhampton.—Progress of Works.—The work of transferring the tramways from the Loraine to the overhead system is being pushed forward. On March 26th the Dudley Road route was completed, and a direct service from Wolverhampton to Dudley thus established.

TELEGRAPH AND TELEPHONE NOTES.

Ireland.—Telephone Service.—On the morning of Easter Monday Sinn Feiners raided a number of telephone exchanges in County Dublin, including those at Kingstown, Foxrock, Blackrock, and Dalkey, dismantling or carrying off all the instruments. At some places the complete switchboards were removed, and at Kingstown even the generator was removed.

Trans-Atlantic Amateur Wireless Telegraphy.—Result of Tests.—The *Wireless World* of March 19th reports the result of the competition which took place on February 2nd, 4th and 6th. No competitor succeeded in receiving the test signals from the United States, but a prize offered by Messrs. Burnham and Co. for the best description of the apparatus used, was won by Mr. W. R Wade, of Clifton, Bristol.

United States.—A Wireless Record.—The world's long-distance record was broken by the U.S. Navy, on March 8th, by the sending of messages within three minutes from Gavite, Philippine Islands, to Washington, a distance of 10,000 miles. The Gavite station sent test messages 7,000 miles to the Goat Island station; the message was then forwarded to San Diego, and thence to Washington. Naval officials are said to attach considerable importance to the record, because it indicates the possibility of abolishing the present system of sending messages by cable *via* Midway Islands, Guam and Honolulu. It was also said that a new automatic control, which was used in making the record, eliminated all handling of messages between originating and receiving points. This would give American warships direct communication with Washington from any point within 3,000 miles of a shore station. —*Reuter's Trade Service* (San Francisco).

West Indies.—Cable Service.—*The Times* reports that in the House of Commons on March 21st, Mr. Baldwin moved: —"That the agreement, dated March 16th, 1921, between His Majesty's Government and the West India and Panama Telegraph Co., Ltd., supplemental to the Agreement, dated August 10th, 1914, entered into between His Majesty's Government, the Government of the Dominion of Canada, the Crown Agents for the Colonies, and the West India and Panama Telegraph Co., Ltd. (H.C. 447, of 1914), be approved." Mr. Pike Pease, Assistant Postmaster-General, in reply to questions, said that the company was actually in a very bad way at the present moment, and its increased expenses had more than absorbed the increased revenue. The need for the whole of the State subsidy was greater than it was in 1914. The company had been obliged to sell practically all its investments, and if the refundments due under Clause 14 of the Agreement were insisted upon it would probably have to cease working almost at once. The whole question of the West Indian telegraph communication was being fully considered by a sub-committee of the Imperial Communications Committee, and it would not be possible at present to bring into operation an alternative service, whether cable or wireless. Therefore it was absolutely necessary to take the course which they had pursued. The Canadian Government had paid its portion of the subsidy up to December 31st last, and he hoped that it might be possible to arrange with it to take the same course which the Government was asking the House to pursue. Lieut.-Col. Amery, Under-Secretary for the Colonies, in answer to Mr. Hurd, said that the West Indies hoped to secure a direct cable service through Bermuda, but he did not think it possible to get such a service within the next year or two. The motion was agreed to.

A White Paper was issued on March 21st containing a copy of the agreement under which His Majesty's Government is entitled to a refund of part of the subsidy paid for the year ended September 30th, 1919. Having regard to the importance of maintaining the service, the present agreement provides for a modification of Clause 14, as a result of which, in any year as from and after the fourth anniversary of the date on which the original agreement came into force, the provision for the refund of subsidy to the Imperial Government, in the contingency stated, is cancelled.

Wireless Telephony.—Lightship's Installation.—The first installation of wireless telephony for commercial purposes in the United Kingdom was inaugurated at Liverpool on March 21st, says *The Times*, between the head offices of the Mersey Docks and Harbour Board and the Mersey bar lightship, 12 miles away. The other two lightships guarding the Mersey entrance are connected with the shore by telegraph cables, but that is impracticable in the case of the bar lightship owing to the heavy currents. The apparatus is the Marconi Co.'s portable set of 100-W power with a 35 miles range. The wave length used is 400 metres, to minimise the possibility of interference with other wireless stations. The apparatus is worked by the ordinary crew of the lightship and the Dock Board's shore staff, and will be used for communicating with ships, and for life-saving purposes as well as to enable Dock Board officials to speak with the lightship.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of ·015 sq. in. two-core, lead-sheathed, wire-armoured, 2,200-V cable.*

June 22nd. Victorian Railway Commissioners. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Belfast.—April 25th. Electricity Department. E.h.p. and l.p. switchgear. (March 18th.)

Belgium.—April 6th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of electricity to the railways in the Louvain section. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

April 11th. The municipal authorities of Schaerbeek, Brussels. Supply of a quantity of electric cable. Particulars can be obtained from the Service d'Électricité, Hotel Communale, Schaerbeek.

April 25th. Deputation Permanente du Limburg. For the establishment of an electricity supply in the Genck-Hasselt-St. Trond district. Copies of the specification and plans can be obtained on application to 99, Rue des Flamands, Louvain, while tenders, on special forms, are to be sent by registered post to Le Gouverneur de la Province de Limburg, Hasselt, Belgium.

Bridgend.—April 12th. Urban District Council. Electricity Department. One 400-kW triple expansion steam engine, direct-coupled to an alternator. (See this issue.)

Canary Islands.—April 7th. The Cabildo Insular de Teneriffe, at Teneriffe, Canary Islands. For the establishment of a telephone service between Santa Cruz de Teneriffe and Guimar.

Cardiff.—April 11th. Welsh National Memorial Association. Electric lighting plant for the Glan Ely Sanatorium. Two 20 kW internal-combustion engine-driven generator sets, battery charging booster, switchboard, and battery of accumulators. (March 25th.)

East Ham.—April 2nd. Electricity Department. L.p. paper-insulated, lead-covered, armoured concentric cable, with necessary joint boxes, &c.; also two c.i. lighting feeder pillars. (March 18th.)

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

Glasgow.—April 2nd. Corporation Electricity Department. Works required in connection with erection of sub station in Buchanan Street. Corporation Electrical Engineer.

Holmfirth.—April 8th. Urban District Council. Electricity Department. Erection of additional overhead mains (approximately four miles). (See this issue.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

The Commercial Secretary to H.M. Legation at Belgrade reports that a prominent business man and proprietor of flour mills in Serbia is contemplating the installation of a complete electric lighting and power station, and is asking for tenders for the necessary plant, which includes one steam engine of 150-h.p., generators, &c., for power for 4,000 to 5,000 lamps (about 90-kW), and overhead cables and conductors for 60 kilometres of circuits (to provide lighting for about 1,400 houses). The name and address of the inquirer may be obtained by United Kingdom firms interested, on application to the Department of Overseas Trade in London.

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (March 18th.)

L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W.1.

New Zealand.—April 19th. Public Works Department. H.M. Trade Commissioner has forwarded particulars of a call for tenders for 6,000 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders (accompanied by deposit of £100) to the Secretary, Public Works Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria, on May 10th. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Maischkel's Buildings, Johannesburg.

Johannesburg.—June 2nd. South African Railways and Harbours. Electrification of Capetown and Simonstown and Durban-Maritzburg lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds. (See this issue.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—New South Wales.—P.M.G.'s Department. Accepted :—

One additional primary-line switch unit for automatic exchange, Balmain, £661.—Automatic Telephones (Aust.), Ltd.

Automatic switchboard material, £180.—Automatic Telephones (Aust.), Ltd.

Victorian Railways Department. Accepted :—

Impregnating plant, spare parts and humidity gauge, for impregnating electrical apparatus with insulating varnishes and solid compounds, £4,463 each.—Gibson Battle (Melbourne), Pty., Ltd.

400-kW transformer, £983.—General Trading Co. —*Tenders.*

Government Contracts.—The following Government contracts were placed during February, 1921 :—

Admiralty : Contract and Purchase Department.

Automatic telephone exchange equipment.—Relay Automatic Telephone Co., Ltd.
Electrically-operated jib crane.—Armstrong & Main, Ltd.
Electrical condenser.—W. A. Hole.
Electric lighting, &c.—G. E. Taylor & Co., Ltd.
Electric fans.—General Electric Co., Ltd.

War Office.

Distributing boards.—General Electric Co., Ltd.; W. Sanders & Co.
Bridge meggers.—Evershed & Vignoles, Ltd.
Electric cells.—Fuller's United Electric Co., Ltd.; Siemens Bros. & Co., Ltd.

Air Ministry.

Electric wiring.—T. Clarke & Co.
Magnetos.—British Thomson-Houston Co., Ltd.,
Magneto spares.—North & Sons.

Post Office.

Protective apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.
Terminal blocks.—General Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd.; Glover & Co.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Cords for telephones.—London Electric Wire Co. & Smiths, Ltd.; Phœnix Telephone & Electric Works, Ltd.
Cable drums.—Macintosh Cable Co., Ltd.
Ducts.—Exors. of the late H. R. Mansfield; Sharp, Jones & Co.
Laying conduits.—Birmingham-Worcester (Section III) and Birmingham-Worcester and Droitwich (Section II) : E. E. Jeavons & Co., Ltd. Canterbury-Ramsgate-Margate, Colchester-Ipswich (Sections I and II), Hampstead (Belsize Park) and Purley-New Oxted (Section II) : O. C. Summers. Ealing (Castlebar) and London-Bristol-Newport (S.-W., Section 5) : Whittaker Ellis. London-Dorking (Section I) : J. Mowlem & Co., Ltd. London-Uxbridge-High Wycombe (Hyde Park, &c.) : G. J. Anderson. Newcastle-Durham (Section Ia) : W. Turner (Ardwick), Ltd. Portsmouth-Ryde : H. Linington. St. Pancras : A. Thomson & Co. Wembley (N. & N.W.) area : J. A. Ewart, Ltd. Widnes-Runcorn : Hodge Bros. (Contractors), Ltd.
Manufacture, supply, drawing-in, and jointing cable.—Chester-Hawarden : British Insulated & Helsby Cables, Ltd. Derby-Sheffield and Sheffield-Leeds : Western Electric Co., Ltd.
Distribution cable plugs.—British Insulated & Helsby Cables Ltd.
Insulator rings.—Avon India-Rubber Co., Ltd.
Solder.—British Insulated & Helsby Cables Ltd.; E. Cowles.
Telephone exchange equipment.—Cambridge : Western Electric Co., Ltd.
Wallboards.—Thornton-Pickard Manufacturing Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.
Copper binding wire.—F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.
Enamelled and silk covered and copper wire.—Phœnix Telephone and Electric Works, Ltd.
Tinned copper wire.—Richard Johnson & Nephew, Ltd.

High Commissioner for India.

Cable.—British Insulated & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.; Pirelli General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); Union Cable Co., Ltd.; Western Electric Co., Ltd.
Inert cells.—Fuller's United Electric Works, Ltd.
Crucibles.—Morgan Crucible Co., Ltd.
Insulator cups.—T. De la Rue & Co., Ltd.
Generating sets.—Lancs. Dynamo & Motor Co., Ltd.
Electric lamps.—General Electric Co., Ltd.
Meters.—Ferranti, Ltd.
Electric motors.—Lancs. Dynamo & Motor Co., Ltd.; Veritys, Ltd.
Stator, &c.—British Thomson-Houston Co., Ltd.
Switchboard.—Erskine Heap & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.
Electric wire.—Derby & Co., Ltd.
Galvanised wire.—R. Johnson & Nephew, Ltd.; Rylands Bros., Ltd.
Iron wire.—Dorman, Long & Co., Ltd.
Steel wire.—Shropshire Iron Co., Ltd.; Siemens Bros. & Co., Ltd.; Whitecross Co., Ltd.

Crown Agents for the Colonies.

Alternator and condensing plant.—C. A. Parsons & Co., Ltd.
Battery.—Tudor Accumulator Co., Ltd.
Cable.—Western Electric Co., Ltd.; W. T. Glover & Co., Ltd.
Cables.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.
Ceiling fans.—General Electric Co., Ltd.
G.I. wire.—Rylands Bros., Ltd.
Insulator cups.—Bullers, Ltd.
Pole distribution boxes.—British Insulated & Helsby Cables, Ltd.
Porcelain grids, &c.—Chloride Electrical Storage Co., Ltd.; Telegraph Iron Works; Bullers, Ltd.
Telegraph line material.—Siemens Bros. & Co., Ltd.; Bullers, Ltd.
Telephone, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Wire.—R. Johnson & Nephew, Ltd.
Bronze and copper wire.—T. Bolton & Sons, Ltd.

H.M. Office of Works.

Engineering services, Royal Mint switchboard : Drake & Gorham, Ltd.
Miscellaneous cable.—Enfield Ediswan Cable Works, Ltd.
Electric cable and wire.—General Electric Co., Ltd.; H. W. Smith & Co. (1920), Ltd.; Hackbridge Cable Co.

Lurgan.—Urban District Council. Accepted :—

Cables for the electricity scheme, £3,156.—Enfield Ediswan Co., Ltd.

New Zealand.—Auckland.—The City Council has accepted the following principal tenders for the extension of the city's electricity system :—

Generator plant, £94,000.—British General Electric Co.
Remainder of machinery, £77,00?.—British Thomson-Houston Co.
Boilers, £81,000.—Babcock & Wilcox, Ltd.
—*Reuter's Trade Service* (Melbourne).

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 1st. At 99, Victoria Street, S.W. At 7.30 p.m. Paper on "Pneumatic Conveyors," by Mr. M. Jennings.

Friday, April 8th. At the Caxton Hall. At 8 p.m. Questions and general discussion.

Institution of Production Engineers.—Saturday, April 2nd. At 2 and 4, Tudor Street, E.C. At 6 p.m. General meeting to approve articles of association and by-laws.

Society of Engineers (Incorp.).—Monday, April 4th. At Burlington House, Piccadilly, W. At 5.30 p.m. Ordinary meeting.

Manchester Wireless Society.—Tuesday, April 5th. At the Albert Hall, Albion Hotel. At 7.30 p.m. Paper on "The History of the Telephone," by Mr. A. Marr.

Paisley Association of Electrical Engineers.—Wednesday, April 6th. At the Y.M.C.A., 25, High Street. At 7.30 p.m. Annual business meeting.

Faraday Society—Joint Meeting with the Institution of Mechanical Engineers, and other Institutions.—Wednesday, April 6th. At the Institution of Mechanical Engineers. At 2.30, 5, and 8 p.m. Discussion on "The Failure of Metals under Internal or Prolonged Stress."

Royal Society of Arts.—Wednesday, April 6th. At John Street, Adelphi, W.C. At 8 pm. Paper on "The Octophone," by Mr. A. Barr.

Chemical Society.—Thursday, April 7th. At Burlington House, Piccadilly. At 8 p.m. Lecture by Dr. F. W. Aston.

Institution of Electrical Engineers.—Thursday, April 7th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Some Recent Developments in Steam Turbine Practice," by Mr. K. Baumann.

Western Centre.—Monday, April 4th. At the Public Library, Swansea. At 6 p.m. Paper on "The Commercial Application of Variable Speed Motors," by Dr. S. Parker Smith.

North-Western Centre.—Wednesday, April 6th. At the College of Technology, Manchester. At 7.30 p.m. Lecture on "Developments in Wireless Telegraphy and Telephony," by Prof. E. W. Marchant.

South-Midland Centre.—Wednesday, April 6th. At the University, Birmingham. Ordinary meeting.

Physical Society of London.—Friday, April 8th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Edinburgh Electrical Society.—Friday, April 8th. At the Philosophical Institute. At 8 p.m. Electrical questions and answers.

Salford Technical and Engineering Society.—Saturday, April 9th. At the Royal Technical College. At 7 p.m. Paper on "Correct Lubrication," by Mr. A. B. Smith.

NOTES.

Bogus Electricity Inspectors.—The *Manchester Guardian* warns its readers that recently many instances have occurred in Manchester of men calling at houses and representing themselves to be employés of the Corporation Electricity Department, obviously with the intention of theft. The genuine inspectors are always in uniform, and bear a written authority, the exhibition of which should be demanded.

Educational.—Birmingham University.—The Council of the Birmingham University is taking steps to bring members of the staple trades of Birmingham and the Midlands into closer relationship with the University by making them acquainted with the opportunities for training of students at the new buildings at Edgbaston. Last Thursday the leading members of the iron and steel trades paid a visit, and they were conducted over the technical departments by Prof. T. Turner. Considerable interest was shown in the electrical engineering, mechanical engineering, and metallurgical departments.

Radium for Paris.—The Municipality of Paris has voted a sum of £100,000 for the purchase of 2 grammes of radium for use in public hospitals.

E.T.B.I. Concert.—A smoking concert has been organised by the Manchester and District Local Advisory Committee of the Electrical Trades Benevolent Institution, which will take place at the Albion Hotel, Piccadilly, Manchester, this evening.

The Batti-Wallahs' Society.—The annual general meeting was held at the Holborn Restaurant on the 21st ult., following the luncheon that this lively Association holds monthly. Among the guests was Mr. Beresford ("Tendency Beresford"), President of the American Institute of Electrical Engineers, and a complimentary reference to his presence brought from him a capital little speech in reply.

The retiring President, Mr. W. Wyld, was in the chair until such time as he gracefully handed it over to the newly-elected President, Mr. W. F. Ireland.

The hon. secretary, Mr. F. Pooley, reported sound progress in 1920, both in numbers and in finance, and the meeting registered a resolve to make the Society still more comprehensive in 1921. Mr. Pooley was presented with a most handsome silver bowl, which was inscribed as a small tribute of esteem and gratitude for his long and splendid services to the Society.

The following is the list of officers elected at the meeting :—President : W. F. Ireland. Vice-Presidents : E. Barralet, C. Newton Russell, E. P. Barfield, R. W. Hughman. Committee : A. W. Blake, H. Foulds, L. S. Richardson, J. P. Maginnis, A. F. Harmer, M. R. Gardener. Hon. Sec. and Treasurer : F. Pooley. Hon. Entertainment Secretary : A. J. Greenly.

Educational Kinemas.—When the Lycées of Paris obtain the kinema sets, which the Minister of Education intends shortly to distribute, they will be applied, in the first instance, says the *Daily Mail*, to the teaching of natural history.

Football.—In a football match at Wigan, between the employés of the Southport Corporation Electric Tramway and the Wigan Corporation Electric Tramway employés, the latter were the victors by 2 to 1.

Service Notes.—Capt. E. B. Hunter, A.M.I.E.E., from the London Electrical Engineers, has been gazetted a major in the Territorial Reserve of Officers, from March 23rd last. Lieut. R. G. Burton, from the London Electrical Engineers, has been similarly appointed to the Territorial Reserve of Officers. Lieut. R. G. Smith, who was in the Territorial Reserve of Officers for some time, has been re-appointed to the Lancashire Fortress Engineers, Territorial Force (Electric Lights Company). Recruiting for the electrical departments of the Navy and Army is very good just now, and a good type of men is being obtained for both Services.

It is officially announced that the Admiralty Experimental Station at Shandon, Dumbartonshire, set up during the war for scientific, experimental, and research work, was to be completely closed down by March 31st. On this date the appointment of Senior Naval Officer, Shandon, held since June, 1919, by Capt. George L. Massey, who in the war was Assistant Director of Paravanes, was to be terminated. The naval part of the Shandon base has been known as H.M.S. *Crescent III*, the *Crescent* being the depôt ship at Rosyth for the Scottish Command, and this unit was also to be paid off on March 31st, says *The Times*. Research work for the Navy will in future be chiefly carried on at the Naval Research Institute at Teddington, which, it is hoped, will be complete by the end of the present financial year. The reason for the abandonment of Shandon was on account of its distance from the open sea and from the experimental schools at the ports, the various scientific institutions, and the Admiralty.

The Consumption of Electricity by Domestic Appliances.—The following figures indicate the value of a steady propaganda in favour of the subsidiary uses of electricity in the home. As most of the appliances named use electricity at lighting rates, we have assumed a price of 6d. per unit :—

	Watts capacity.	Use, hours per annum.	Units, per annum.
100 fans	100	100	1,0.0
100 irons	300	150	4,500
100 table hot-plates... ...	200	100	2,000
100 kettles	500	100	5,000
100 water or milk-heaters ...	250	50	1,250
100 toasters...	200	60	1.200
100 vacuum cleaners ...	250	300	7,500
100 washing machines ...	250	150	3,750
800 pieces.			26,200

26,200 units at 6d. = £655 per annum.

If the peak load is not increased by the use of these devices, the cost of the energy is only that ascribed to "running costs," so that the bulk of the revenue is net profit.

Appointments Vacant.—Tramway overhead linesmen (78s. 8d.), for the Borough of Wigan Tramways Department; shift engineer, for the Rawtenstall Corporation Electricity Department. See our advertisement pages to-day.

A Municipal Exhibition.—To educate the public up to the advantages conferred by the use of electricity should be one of the first considerations of a municipality owning an electricity undertaking. We are pleased to see that Aylesbury set an excellent example in this direction by the organisation of an electrical exhibition, last week. The show, which was formally opened by the Mayor, Alderman James Robinson, on March 21st, was arranged by the borough electrical engineer (Mr. W. A. Turnbull) and his staff, and their efforts were amply rewarded by the keen interest shown by the visitors. The exhibition covered both domestic and agricultural appliances, and these were shown in working. The best way of all was chosen for the display of the domestic side of the show—*i.e.*, by arranging the exhibits in their correct surroundings, in a bedroom, drawing room, dining room, and kitchen. Each room presented an example of correct and scientific lighting and heating. Local firms carried out the decoration and furnishing. Among the devices which appeared were "Carola" heating pads in the bedroom, a "Lightning" oven in the kitchen, and "Aqua" and "Stanton" water-heaters supplying hot water to a bath. The Western Electric Co., Ltd., was very much to the fore, its stand bearing examples of many of its appliances, including a washing machine, a dish washer, a sewing machine, and vacuum cleaners. The stand was illuminated by means of flood lighting. Mr. Gowan, an enterprising local contractor, was responsible for a most imposing display in the centre of the hall. Assisted by demonstrators, Mr. Gowan showed washing machines, cookers, and smaller apparatus under working conditions. A number of lighting sets were exhibited by various firms, these including "Lalley Light," "Austin," and "Aster" sets. The Jackson Electric Stove Co. had an excellent range of its products, and cooking was carried on continuously.

Upon the agricultural side were gravel crushers, fodder slicers, milk separators, and centrifugal pumps, automatically controlled, the principal manufacturers represented being Messrs. Brown and Sons, of Leighton Buzzard. A 2½-ton electric vehicle, built by Messrs. Ransomes, Sims & Jefferies, Ltd., was driven round the district by Messrs. Messey & Co., Ltd, to advertise the exhibition. Other exhibitors included the General Electric Co., Ltd., the Hot Point Co., the Bastian Co., the British Electric Transformer Co., Ltd., &c.

The latest aid to publicity—the kinematograph—was made full use of, both the Western Electric Co. and the Hoover Suction Cleaner Co. loaning films for the purpose.

Many useful lectures were given to appreciative audiences, among the speakers being Mr. J. W. Beauchamp, of the British Electrical Development Association; Mr. Napier Prentice, of Felixstowe; Mr. Borlase Matthews, A.M.I.C.E., and Mr. W. T. Kerr, borough electrical engineer, Hereford, who lectured on the applications of electricity to agriculture. Mr. W. A. Turnbull also lectured, and Mr. Ll. B. Atkinson, President I.E.E., was present on March 24th.

It is to be hoped that the exhibition will be followed by a tremendous rush for electricity and electrical appliances. Much of the success was due to Mrs. W. A. Turnbull, who rendered valuable assistance in demonstrating for and instructing lady visitors.

After the close of the show the staff was entertained to supper by Mr. Turnbull, when they were thanked for their good work.

The Metric System in Japan.—The Director of the International Bureau of Weights and Measures has informed the Academy of Sciences that the Japanese Parliament has passed an Act for the compulsory adoption of the metric system.

Electrical Apprentices.—In reply to an advertisement for three apprentices at Burnley electricity works, the Corporation has received 100 applications.

Empire Naval Policy.—The Memorandum supplementing Lord Lee's statement reviewing the history of the past year states, says the *Times*, that it is hoped that the Naval Research Institution at Teddington close to the National Physical Laboratory will be complete by the end of the present financial year. Referring to "the very economical arrangements made with regard to optical research and experiment," the memorandum says:—"It was arranged earlier in the year that the requirements of the fighting services could best be met by co-operation, and it has been decided that the Admiralty shall maintain an Optical Section at the Naval Research Institution which shall carry out research and experiment for both the Navy and Army. Until the Admiralty building at Teddington is complete the Optical Section will be housed by the National Physical Laboratory. In a somewhat similar way it has been possible to centralise research work in gyroscopes, it having been decided to continue such research work at the Royal Naval College, Greenwich."

A Division of the Naval Staff has been made responsible for formulating proposals for the commercial application of scientific devices, originally developed for naval purposes, which may be suitable for commercial application. The Admiralty proposes to lay a leader cable in a position where its commercial application can be fully demonstrated, in order that the Mercantile Marine may have every opportunity of investigating the practical commercial value of the device. It is believed that the adoption of leader gear off the entrances to some of our commercial ports will prevent considerable losses both of time and material.

Many directional wireless telegraphy stations were set up on the coasts of the United Kingdom during the war, and several of these, since the Armistice, have been placed at the disposal of ships of the Mercantile Marine. As the stations are not required in peace time for naval work, they are being turned over to the Post Office, except one which will be employed on development and research work.

The policy with regard to deck and engineer officers set out last year has been continued, and it is proposed to introduce certain modifications in the present system of engineering training. The time has arrived for arranging gradually to transfer the duties in connection with the electrical installations of H.M. ships from the charge of the torpedo lieutenant, a deck officer, with whom it is vested at present, to the engineering side. The maintenance in an efficient condition of electrical machinery is a similar function to that of the maintenance of other machinery on board ships; the proposals, therefore, for the future training of officers for the engineering branch make provision for a proportion of those officers to become electrical engineering specialists. It has been deemed desirable to arrange for the separation of deck and engineering branches to take place earlier than has hitherto been the case. Those on the engineering side require, before proceeding to sea, to receive a thorough grounding in engineering and electricity, and to undergo a period of practical work in the workshops. For this purpose they will first proceed for three years' training at the Engineering College at Keyham, and will undergo a course similar to the one which all engineer officers in H.M. Navy formerly underwent, and which gave us the splendid body of officers to whom we owe the engineering efficiency of the fleet during the war. On completion of this course they will then proceed to sea to carry out engineering duties afloat. Specially selected officers will be given the appropriate advanced courses at Greenwich as may be necessary. Those officers who have qualified in the advanced marine engineering course will be eligible as at present for the higher posts; those who have qualified in the advanced electrical course will be employed in ships requiring them and will be eligible for selection for the higher electrical positions. As specialist electrical officers become available the electrical installations in the more important ships now in charge of torpedo lieutenants will be transferred to them, and in the less important ships the electrical installations will be in charge of an engineer officer.

Electricity (Supply) (No. 2) Bill.—A special committee appointed by the Council of the Association of Municipal Corporations had an interview with Mr. Arthur Neal, Parliamentary Secretary of the Ministry of Transport, and the Electricity Commissioners, on January 21st, and recently issued a report on the No. 2 Bill, suggesting various modifications. The report has been adopted by the Council. The Committee suggests that a joint authority shall not be restricted in borrowing for working capital to a period of three years, as laid down in Clause 1, since it may require no capital during that period, but may need it later. With regard to Clause 2, the Committee would extend the permission to suspend sinking-fund payments to cover all moneys borrowed for the purposes of the Electricity (Supply) Acts, and not only loans raised subsequently to the passing of No. 2 Bill; it would also add power to capitalise interest during construction. By the Act of 1919, the expenses of the Electricity Commissioners are placed upon the shoulders of the joint electricity authorities and authorised undertakers of the United Kingdom; as they are, in effect, a Government department, objection is raised to the provision, and it is urged that Sec. 29 of the Act of 1919 should not be amended but repealed. Clause 8 authorises the Minister to transfer to a joint authority the whole or part of the undertaking of an authorised undertaker who is unable to supply electricity, or to empower the joint authority to supply electricity within the area: it is proposed that this power to supply in default shall extend only to that part of the area within which the authorised undertaker is unable to give the supply. Clause 13 provides that deficiencies in the accounts of a joint authority may be met by contributions levied from the constituent bodies represented on the joint authority, objection is taken to the provisions of the clause so far as they are compulsory.

Clause 15 extends the period for repayment of sums advanced by the Treasury for urgent works from two to five years; the Committee desires that the period shall be further extended to 15 years, but Mr. Neal, at the interview, pointed out that the intention was not to finance the joint electricity authority, but to save time by providing money for urgent works while the authority was being established and got into working order. Directly the works were handed over to the authority, the latter should provide the money. The clause was intended to ease the burden by extending the time and providing for payment by instalments.

Radio-Activity and Plant Growth.—According to an article by Prof. G. Petit, in *La Nature*, experiments have shown conclusively that radio-active substances have an important effect on the growth of plants, provided that too great a quantity of the substance is not employed. Researches are in progress to determine the best conditions and methods of application, and the manner in which the improved results are brought about.

INSTITUTION NOTES.

The Institution of Electrical Engineers.—Liverpool Sub-Centre.—Mr. Mallinson read his paper on "Electric Driving in the Paper Mill on Heat-economy Lines" before the Liverpool Sub-Centre, on March 21st. Mr. T. D. Clothier, in opening the discussion, remarked on the low speeds referred to, and questioned whether these could not be boosted up. He also referred to the high percentage of energy required to drive the machinery required for paper-making against that actually used for the manufacture. Mr. Rattenbury offered some useful suggestions that he thought might overcome the switchgear difficulties enumerated by Mr. Mallinson. Mr. Malpas referred to the heating of paper mills, and asked several questions dealing with the technical manufacture of paper. Messrs. Cooper and Wilson also took part in the discussion.

Western Centre.—An ordinary general meeting will be held at Swansea on Monday, April 4th, when Dr. S. Parker Smith, of the City and Guilds Engineering College, London, will deliver a lecture on "The Commercial Application of Variable-Speed Motors."

Previous to the meeting at Bristol on May 2nd, when the Centre will be addressed by the President, Mr. Llewelyn B. Atkinson, it is proposed to hold a dinner if a sufficient number of members are willing. Early application for tickets should be made to Mr. A. J. Ostler, Electricity Department, The Exchange, Corn Street, Bristol.

The annual report for the 1919-1920 Session of this Centre states that the session (the eighth) has been an important one, following upon the extension of the area referred to in the last annual report. Seven meetings—four in Cardiff two in Bristol, and one in Swansea—were held. The latter was the first held by the Western Centre in Swansea, and it was most successful.

The attendance at all the meetings has been such as to encourage the Committee in increasing the scope of its operations, and it will no doubt further consider the junior members of the Centre, and provide means whereby they will be able to take a greater part in the discussions.

The membership of the Centre for 1920 was as follows:—Members, 75; associate members, 218; associates, 15; graduates, 54; students, 73; total, 415.

The Faraday Society and Engineering Institutions.—A joint general discussion on "The Failure of Metals under Internal and Prolonged Stress" will be held in the Hall of the Institution of Mechanical Engineers, on Wednesday, April 6th, from 2.30 to 10.30 p.m., by the Faraday Society, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institute of Metals, the North-East Coast Institution of Engineers and Shipbuilders, the West of Scotland Iron and Steel Institute, and the Institution of Engineers and Shipbuilders in Scotland.

An introductory address will be read by Dr. W. Rosenhain, F.R.S., giving a general survey of the subject. Papers of a general character will occupy the rest of the afternoon, and the second session, 5 to 6.30 p.m., will be devoted to a general discussion. After dinner there will follow papers and discussions dealing with 'Causes of Failure of Brass and Steel." Amongst the papers to be presented are the following:—L. Archoutt: "Failure of the Lead Sheathing of Telegraph Cables"; H. S. Rawdon: "The Presence of Internal Fractures in Steel Rails, and their Relation to the Behaviour of the Material under Service Stresses."

Royal Institution.—The "Tyndall Lectures" will be delivered by Mr. C. T. R. Wilson, who will speak on "Thunderstorms," beginning on Thursday, April 7th.

Edinburgh Electrical Society.—At a meeting held on March 25th, Mr. W. Leithead delivered a lecture on "Automatic Telephones." After a brief reference to the history and varieties of automatic exchanges, the lecturer gave a very full and detailed description of the Strowger apparatus. He showed how preliminary difficulties had been overcome and the modern gear perfected. The lecture was illustrated by lantern slides and diagrams. In the course of the discussion, Mr. J. Plucknett submitted some particulars of the "Relay" automatic system, and strongly supported its claims for wider adoption on the grounds of simplicity.

Institution of Civil Engineers.—In a recent circular to members the Council referred to the proposed legislation to regulate the qualifications of civil engineers and to define and limit the use of the title "civil engineer," and remarked that the original proposal to effect this object by means of a private Bill was found to be impossible; the Council had considered whether the desired object could be satisfactorily secured by means of a public Bill, and discussed the subject with other engineering Institutions, but decided not to follow that course. The adoption of a descriptive title to be used exclusively by those who possess, in the words of the Institution's original Charter, "the knowledge which constitutes the profession of a civil engineer," was then considered, and it was decided that the most appropriate professional designation which could be effectively limited in its use in the way desired was "chartered civil engineer." The Council, acting under legal advice, has decided to apply to the Privy Council for the grant of a supplemental Royal Charter to confer the use of the professional description "chartered civil engineer" upon corporate members of the Institution.

Liverpool Engineering Society.—At a meeting of the Society on March 30th, Mr. F. W. Macaulay, M.Inst.C.E., read a paper on "Some Considerations on the Choice of Materials for Pressure Aqueducts." In the course of his paper the author stated that water engineers who had charge of cast-iron mains laid within the last 30 or 40 years were faced to-day with very serious difficulties and problems owing to the more or less rapid deterioration of the discharging capacity of their mains. As an instance, it had been found that the three cast-iron mains on Manchester's Thirlmere aqueduct lost 35 per cent. of their original capacity in 15 years, and 40 per cent. in 20 years. The deterioration of large mains of the Leeds Waterworks was said to be still higher.

The problem before manufacturers was to find a method whereby the theoretical quantity of steel necessary to withstand internal working pressures might be formed economically into a pipe which, while stiff and rigid to prevent deformation by external pressure, would be protected against corrosion and bacterial action. The author dealt at some length with reinforced concrete pipes mentioning that devised by M. Bonna, consisting of a steel cylinder between internal and external steel helices of cruciform section, the whole embedded in concrete. The "Hume" pipe was described. This is made by a centrifugal process, the concrete being reinforced with steel wire. This type of pipe has proved of great value, and the author described a number of examples which he had seen. A patent recently had been taken out by a South African, for lining metal tubes with unreinforced concrete, and pipes of from 3 to 24 in. in diameter already had been dealt with by this method. The author saw no reason why equal results could not be obtained with tubes of much larger diameter.

The annual general meeting will be held on April 27th, when the business will include the announcement of election of Council and officers, and announcement of awards of the Derby Gold Medal, the Society's Premium, and presentation of Diploma Certificates to those elected during the session.

Chelmsford Engineering Society.—The first annual conversazione was held on March 18th, at the Arc Works' Club Rooms (by kind permission of Messrs. Crompton & Co., Ltd.). Many prominent engineers were present, and the Mayor, Alderman J. O. Thompson, O.B.E., also attended. The President, Mr. T. E. Dann, in a brief address, welcomed the guests. The first half of an excellent concert followed, and refreshments were then served.

During the interval a number of working models and subjects of scientific interest were on view (under the supervision of Mr. H. Church). They proved of great interest, and included a demonstration of wireless telephony by the Marconi W.T. Co., exhibits of

soap bubble formation, microscopic slides, colour photographs, a demonstration by Messrs. Crompton & Co. of the "Robertson" stroboscopic vibrator, and various electrical apparatus manufactured in Chelmsford about 35 years ago. The President in an interesting speech, laid stress on the important part played by engineers in the development and every-day life of the community, and pointed out the need for such a Society as this in the town, by means of which engineers were able to meet and enjoy the advantages of discussion The secretary, Mr. H. Spencer, gave a brief history of the Society, followed by a pleasing address from the Mayor on behalf of the guests. The second half of the concert programme was then proceeded with.

Stoke-on-Trent Association of Engineers.—The members of the Association were recently conducted over the Burslem Electricity Works by the Stoke-on-Trent chief electrical engineer (Mr. C. H. Yeaman). Mr. Yeaman outlined the history of electricity supply in the district, and an interesting afternoon was spent. In the evening a students' competition was held, each participant being desired to describe the construction and uses of various locomotive parts.

Iron and Steel Institute.—The annual meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on May 5th and 6th, commencing each day at 10 a.m. The programme of proceedings includes on May 5th a general meeting of members and annual dinner at the Connaught Rooms; on May 6th the following papers (among others) will be read:—"Notes on the Cleaning of Blast-furnace Gas," by S. H. Fowles; "Slip-lines and Twinning in Electro-deposited Iron," by W. E. Hughes; "Röntgen Spectographic Investigations of Iron and Steel," by A. Westgren.

An invitation has been received from the Comité des Forges de France for the Institute to hold its autumn meeting in Paris early in September. After the meeting, arrangements will be made to enable members attending to visit works in Lorraine, Creusot, and Normandy.

Association of Mining Electrical Engineers.—A meeting of the Midland Branch of the Association was held on March 19th, at Derby. Mr. A. W. Williams read a paper on "Insulators: Their Duties, and the Maintenance of Insulation." Of course, the paper was directed chiefly to the use of insulators in mines; an instructive discussion followed the reading of the paper.

Institution of Engineers, India.—The inaugural meeting of the Institution was to take place on February 23rd. The Viceroy and the Governor of Bengal were to be present, and the presidential address was to be delivered by Sir Rajendra Nath Mookerjee. Amongst the papers read during the meeting were:—"Development of Electrochemical Industries in India," by Dr. Fermor, of the Geographical Survey of India; "Electricity in the Jute Mill," by Dr. Crowley; "Driving Belts as a Source of Waste in Factories," by Mr. T. C. Weston, Deputy Director of Industries, Bengal. The first annual dinner was to be held on February 24th, when the Governor of Bengal and other distinguished guests were expected to attend. The address of the Secretary is Post-box 462, Calcutta.—*Indian Engineering.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. R. McGregor, who has for some years past been chief mechanical engineer to Messrs. J. G. White & Co., Ltd., London, electrical, mechanical, and civil engineers, and who in this capacity has been responsible for the design, erection, and putting to work of large power stations all over the world, is relinquishing this position to become engineer and manager of Messrs. Clayton and Shuttleworth, Ltd., Lincoln, where he will be more particularly responsible for the development of their water-tube boiler business. This firm possesses one of the finest boiler works in the country, and for some time past has been manufacturing water-tube boilers on a design which is claimed to represent a marked advance on existing construction. It is intended to develop the manufacture and sale of these boilers as the principal activity of the firm.

Mr. E. T. Newborn, shift engineer at the Doncaster Corporation electricity works, who is leaving to take up a position in London, has been presented by the staff with a leather suit case.

Keighley Town Council renewed a debate, last week, on the subject of the salary of the newly-appointed electrical engineer (Mr. Webber, who recently relinquished his position as tramway manager, on the separation of the two posts). A previous recommendation by a Committee had been referred back by the Council, and the Committee now introduced alternative proposals that the salary for this new post be £750 per annum, or that it be £750 per annum from the time of relinquishing the tramway duties to March 31st, 1921, and for one year from April 1st, £600, plus 5 per cent. of any net profits made by the electricity department. In discussion, it was pointed out that the latter proposal would need a profit of £3,000 to make the salary reach £750. Eventually it was decided that the salary should be £750, including war bonus.

At a meeting of the Blackpool Salaries Committee it was decided to recommend an increase in the salary of the electrical engineer and tramways manager from £1,250 to £1,500 a year. Mr. Furness was receiving £900 per year for these dual positions up to August, 1919, when his salary was increased by £350, bringing the total up to £1,250.

Obituary.—Mr. M. B. Kenworthy.—The death is announced at Stafford of Mr. Marchand B. Kenworthy, chief engineer at the English Electric Co.'s (late Siemens') works, Stafford, at the age of 41 years. He was a native of Saddleworth, Lancs., and came to Stafford about 17 years ago to take up a position as draughtsman at Messrs. Siemens Bros.' works, rising to the position of chief engineer. For many years he had been instructor in machine construction and drawing at the Stafford Municipal Technical School.

Mr. J. G. Hancox.—The death is announced, at Rhyl, of Mr. J. G. Hancox, engineer, of Darlaston. For some time he occupied a position of responsibility with the Bradford Corporation electricity undertaking, and in 1915 he became assistant works engineer at the Metropolitan Carriage Works, Saltley, near Birmingham.

The death was announced, last week, of Dr. Ironside Bruce, radiologist to Charing Cross Hospital. This gentleman is another of a long line of X-ray workers who have given their lives in humanity's service. Dr. Bruce's continual exposure to unscreened rays led to the development of an acute form of anæmia, which ultimately caused his death at the early age of 45. Dr. Bruce was educated at Aberdeen, and saw service during the South African War.

Dr. A. Leray.—French science had a parallel loss on March 26th to that caused to England by the recent death of Dr. Ironside Bruce. The latest victim in France to the dangers of X ray research is Dr. Adolphe Leray, for 25 years director of the Radiographical Laboratory at the St. Antoine Hospital, at Paris. Dr. Leray made 35,000 radiographic examinations during the war, refusing to take any rest until after the armistice.

Mr. Edward Campbell.—We regret to record the death, which occurred at Edinburgh on March 25th, of Mr. Edward Campbell, who was superintending engineer, Telegraph Department, G.P.O., Edinburgh, from January, 1902, to April, 1905. The deceased gentleman was nearing his 77th birthday.

NEW COMPANIES REGISTERED.

Armstrong Sparking Plug Co., Ltd. (173,762).—Private company. Registered March 18th. Capital, £6,030 in 6,000 ordinary shares of £1 each and 000 deferred shares of 1s. each. To carry on the business of dealers in sparking plugs, carburettors, magnetos, engines, wings, radiators, and other components for the construction and repair of motor vehicles, &c., and to adopt an agreement with A. W. Armstrong. The subscribers (each with one share) are: C. D. Im Thurn, Springle House, Harley, near Hertford, gentleman; and F. F. Day, 56, Norfolk Square, Hyde Park, W.2, gentleman. The subscribers are to appoint the first directors. Qualification: £300. Secretary: J. H. Im Thurn. Registered office: 22, Broadway, Westminster, S.W. 1.

Regan, Bennett & Co., Ltd. (173,779).—Private company. Registered March 18th. Capital, £5,000 in 2,000 10 per cent. cumulative preference shares of £1 each and 60,000 ordinary shares of 1s. each. To carry on the business of electrical and mechanical engineers, electricians, manufacturers of, dealers in, and agents for metal filament and gasfilled electric lamps, &c. The first directors are: J. W. Regan, 32, Charing Cross, Whitehall, S.W. 1; W. H. Bennett, 32, Charing Cross, Whitehall, S.W. 1; A. L. Martin, 32, Charing Cross, Whitehall, S.W. 1. Registered office: 32, Charing Cross, Whitehall, S.W. 1.

Rely-a-Bell Burglar & Fire Alarm Co., Ltd. (173,780).—Private company. Registered March 18th. Capital, £1,000 in £1 shares. To adopt an agreement with Thomas Gunn, Ltd., and H. J. Tibbles, for the purchase of certain patents for burglar and fire alarms, &c. The first directors are: F. V. Gunn, 8, Livingstone Mansions, West Kensington (director of Thomas Gunn, Ltd.); M. Gunn, Caroline House, Heath Street, Hampstead (director of Thomas Gunn, Ltd.); H. J. Tibbles, Oakdene, Leigh Beck, Canvey Island. Registered office: 80a, Coleman Street, E.C. 2.

Aqua Electric Co., Ltd. (173,740).—Private company. Registered March 17th. Capital, £8,000 in £1 shares. To carry on the business of electrical, gas and water engineers, machinists, fitters, millwrights, &c. The first directors are: A. S. Dorsey, 168, Regent Street, W.; A. S. Haxton, 168, Regent Street, W.; E. F. Spencer, 37, Park Mansions, Vauxhall Park, S.W. Registered office: 168, Regent Street, W.

Gilbert Gilkes & Co., Ltd. (173,768).—Private company. Registered March 18th. Capital, £36,200 in £1 shares. To take over the business of civil, mechanical, and electrical engineers carried on at the Canal Iron Works, Kendal, Westmorland, and to adopt an agreement with Gilbert Gilkes & Co., Ltd., and L. L. Samuels, the liquidator thereof. The first directors are: N. F. Wilson, Elmhurst, Kendal; E. Crewdson, Low Slack, Kendal; R. W. Pennington, 4, Wood Lea, Kendal; W. M. Harris, Holmfield, Kendal. Registered office: Canal Iron Works, Kendal, Westmorland.

D. O. Williams & Co., Ltd. (173,806).—Private company. Registered March 21st. Capital, £2,000 in £1 shares. To take over the business of electrical engineers, installation and general contractors, &c., carried on at High Street, Clydach, Glam., as D. O. Williams & Co. The permanent directors are: J. T. Davies, 31, Wellfield Road, Cardiff; W. M. Wilson, 24, Pontygwyder Road, Swansea (managing director). Registered office: High Street, Clydach, Glam.

Guy V. Laycock, Ltd. (173,770).—Private company. Registered March 18th. Capital, £10,000 in £1 shares. To take over the business of an electrician and electrical engineer and merchant carried on by Beatrice S. Laycock at Cloth Hall Street, Huddersfield, as "Guy V. Laycock." The first directors are: Beatrice S. Laycock, Garrowby, Greenhead Road, Huddersfield; H. P. Ripley, 7, Regent Road, Edgerton, Huddersfield; W. H. Laycock, 22, Cecil Street, Huddersfield. Qualification, 100 shares. Remuneration as fixed by the company. Registered office: 12, Cloth Hall Street, Huddersfield.

M. E. C. Electrical Co., Ltd. (173,800).—Private company. Registered March 19th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, &c. The first directors are: H. F. Collier, 9, Stoney Lane, Birmingham; I. F. Milne, 9, Stoney Lane, Birmingham; F. Westwood, 9, Stoney Lane, Birmingham. Registered office: 9, Stoney Lane, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire United Tramways, Ltd.—Issues on various dates from April 6th, 1906, to March 1st, 1921, of £300,000 debentures, part of a series already registered.

Melvin Engineering Co., Ltd.—Debenture dated March 14th, 1921, to secure £1,150 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Lieut.-Commander J. W. Seddon, The Fosters, Hendon, N.W. 4.

Cambridge Electric Supply Co., Ltd.—Issue on March 7th, 1921, of £3,550 debentures, part of a series already registered.

Rapid Accumulator Co., Ltd.—Deposit on March 1st, 1921, of deeds of certain land in Mount Road, Hayes, Middlesex, to secure all moneys due or to become due from company to Barclays Bank, Ltd.

CITY NOTES.

British Aluminium Co., Ltd.

The profits for 1920, after making provision for E.P.D. and corporation tax, amount to £428,157, plus £15,314 brought forward. Income tax, depreciation of investments, and proportion of profits payable to directors require £114,636; prior lien debenture service fund, £48,000; debenture stock service fund, £43,224; reserve for depreciation, £50,000; reserve account, £50,000. The 6 per cent. dividends on the preference shares (less tax) absorb £17,974. The total distribution on the ordinary shares is 10 per cent. for the year, less tax, requiring £100,103, and £19,534 is carried forward. The reserve account, after deducting the sum of £400,414 which was capitalised as at January 1st, 1920, and distributed to the ordinary shareholders, stood at £120,000, and there has been added out of the profits of the year £50,000, increasing the amount to £170,000. The depreciation reserve account has been increased by the sum of £50,000 out of the profits of the year, and now stands at £550,000. The buildings, works, and plant at the various factories have been fully maintained out of revenue. Considerable additions have been made at the Alumina works in Scotland, and at the rolling mills at Warrington, in order to provide increased capacity at those works. All the works of the company have been fully employed during the year. The demand for the metal during the first half of the year could not be met, but a sudden falling off was experienced in the autumn, in common with all other non-ferrous metals, and these conditions still continue. In consequence, it has been necessary since the close of the year to curtail seriously the output at the various works. It is hoped, however, that the general depression in the metal industry may soon be relieved. Meeting held yesterday, March 31st.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

The annual meeting was held in Newcastle on March 22nd. Mr. J. H. Armstrong, who presided, formally moved the adoption of the report, but, in view of his pending retirement, left it to his successor, Mr. R. P. Sloan, to deal with the accounts.

Mr. Sloan said the past year had been one of considerable progress, but it had been one of anxiety and difficulty. The miners' strike caused considerable disorganisation, but although their coal deliveries were entirely suspended, their stocks were sufficient for them to supply all demands upon their system. It had been expected that during the latter part of 1920 they would have derived some revenue benefit from the new generating plant on the Tees and at Dunston. In that hope they were disappointed. At Dunston they obtained no commercial use of the new plant until the beginning of this year, and the plant on the Tees was only brought into commercial operation some four days ago. This delay had caused them much anxiety, but the cause for that was now disappearing. Owing to the time taken in carrying out power station extensions, the directors had been handicapped by having to meet capital charges before any financial benefit accrued. The interest charges under that head had been particularly heavy, and were estimated on account of 1920 to have amounted to over £60,000. This had been met out of revenue, but the burden became greater as the business developed, and the directors had been considering whether they should to some extent modify that policy. The connections made to the system during the year totalled 25,203 h.p., and with those made in the Cleveland area, an additional 16,846 h.p., made a total of 42,049 h.p., which was a record. Their profit for the year, £392,643, was £144,449 in excess of 1919, and £50,249 over 1918. From the profits £30,000 had been transferred to reserve for plant renewals and improvements, which fund now stood at £372,241. Referring to the cost of labour, he pointed out that the salaries and wages bill amounted to £394,195, as compared with £296,124 in 1919, an increase of £98,071. The average remuneration per employé now represented an increase of 177 per cent. They were hoping there might be some relief in respect of this cost. The North-Eastern Railway main line electrification scheme, to which he had formerly referred, had not materialised, but he was glad to be able to state that after some considerable lapse of time, negotiations had been reopened by the Railway Co., and there was a reasonable hope that the scheme might be proceeded with, although on a somewhat smaller scale than was contemplated in the first instance. In the event of the scheme maturing, and proving a success, there was every likelihood of its leading to much larger developments. Having referred to legislative matters, the speaker said with regard to the prospects of the company during the current year, it was extremely difficult to make any forecast. Opinions differed very widely as to the probable duration of the slump in trade, and as to how long costs would remain at their present high level. Since the commencement of the year they had felt the effect of the great trade depression. Their output of electrical energy had, however, during the first eleven weeks of the year been increased by 5 per cent., compared with that of 1920. That was not a large figure, but it was encouraging in view of present circumstances, and indicated that they were benefiting to some extent as a result of the increased business obtained during the course of last year. They should during the year reap some considerable revenue benefit from the operation of the new generating plant on the Tees and at Dunston, and, further, they had on hand at present additional applications for connections to the system representing over 70,000 h.p.

The Hon. R. H. Brand thought shareholders could congratulate themselves on the position of the company. He hoped and believed they were through the era of strikes, and that the trouble so caused to their business would be diminished. Apart from the benefit they might derive from their new plant, the situation was more obscure than ever. The results of the company's working was bound to reflect the general industrial conditions on the North-East Coast, and it was impossible yet to say what its course would be. He thought it mainly depended on two things: first, a reduction in manufacturing costs by satisfactory arrangements between labour and capital; and, next, political peace. As to the latter, he regarded the result of the recent London Conference as a very serious blow to the revival of trade. In face of all this uncertainty they were bound to exercise care. They had determined to postpone all new capital expenditure as far as they safely could, but they had not yet completed the large programme they entered into before the end of the war, and which had been very much delayed. The cost, of course, had been considerably more than had been expected. Their issue 15 months ago of £1,500,000 7 per cent. preference shares had carried them through 1920. Recently it had been necessary to find more money by the sale of £500,000 nominal of their first debenture stock, and during the course of the year they should have to raise further capital, either by the sale of the first and second debentures still available, or in some other way. In view of the changing financial conditions, and the possibility of cheaper money towards the end of the year, they did not want to settle the actual methods they might adopt before it was necessary; but it was probable they might later in the year ask for sanction for the creation of more preference shares. They would prefer to have issued more ordinary shares, but that would not be possible until financial conditions improved. The company occupied a very special position. They were by far the largest electrical supply company in the kingdom, and their prosperity was absolutely essential to the whole industry of the North-East Coast, and if they were to serve that industry they must extend their operations with the expanding needs of the area they supplied. In fact, they had to anticipate the needs, incurring large expenditures of capital, which they had to raise from the public. This money they could not get unless their financial position was strong, which meant that they must have a reasonable return for their capital. They had come through a very difficult time and he looked forward to a much improved situation in the future.

The report and dividends were approved.

The chairman then referred to his retirement from the position of chairman of the company, and said Mr. R. P. Sloan, who had consented to act as his successor, would add the work of chairman to his present duties of manager, under the title of chairman and managing director. Mr. Sloan had acted as manager for 16 years, and had been a director for six years.

British Insulated and Helsby Cables, Ltd.

The twenty-fifth annual meeting was held on March 21st in Liverpool. Mr. James Taylor (chairman) presided. He said that the profit for the year amounted to £340,713, an increase of £12,024 over the previous year. Such a result was very satisfactory, especially when taken in conjunction with the many and unusual difficulties that had to be contended with. Two stonpages occurred at the principal works at Prescot—one due to the coal strike and the other to certain unreasonable demands by workmen, which resulted in three weeks' work being lost. The workmen suffered a heavy loss in wages and the company in profits, in addition to which there were disorganising effects and an accumulation of costly raw materials. In addition men in the wire drawing department adopted the "ca' canny" policy in an effort to defeat the bonus system, which had been in operation for many years, and to bring about the substitution of a flat rate wage as high as the bonus system ensured. The company refused the demand, with the result that about 70 expert wire drawers who declined to continue on the old system had to leave the service. Some time was required to train fresh hands, but by persistent effort the

difficulty was overcome, and now the new men were doing as much per week as the old and more experienced men were doing. These methods resulted eventually in the company being unable to turn out the usual and proper quantity of cable per week. Apart from these stoppages the works, both at Prescot and Helsby, had been busy throughout the year, and the present state of the order book was quite satisfactory. Present high costs of manufacture and inability to give certain delivery, owing to labour unrest, were preventing the company from taking orders, which were now being placed abroad. Foreign trade could only be retained by a reduction in the cost of production, and although a decrease in the present high rate of wages would have a most beneficial effect, another and very important element had to be considered, namely, increased efficiency in the mechanical means of production. The company therefore had carried out a reorganisation of the works. They had built what were practically three new factories, fitted with all the latest and most improved appliances, and had enlarged the power plant. They had also greatly improved and increased the facilities for handling raw material and finished products, besides making improvements in other departments, which should largely tend to cheapen production. The company had now been working under the improved conditions and additional facilities for the past two or three months, and while they were feeling the beneficial results of the changes generally, it was noteworthy that they could now turn out all the latest types of special high tension cables of very great lengths. It was believed that capital expenditure for some time would be relatively small, and the prices of raw material having fallen and the peak of the company's financial requirements passed, it would not be necessary to issue any of the new capital already authorised.

Clyde Valley Electrical Power Co.

At the annual general meeting held in Glasgow last week, Mr. Charles Ker, deputy chairman, who presided in the absence of the chairman, referred to the effect on the company's business of the high price of coal, which accounts for over 60 per cent. of the total cost of production. This does not affect the company directly so seriously as it might appear, as due to their sliding scale of charges, they are enabled to pass on a certain proportion of the increase to their customers, but the effect of the high price of coal on industry generally tends to restrict the output of electricity. In his opinion there can be no real prosperity in industry until the price of coal becomes more normal. He also referred to the heavy burden of taxation. In view of the high cost of production, the profit for the year was most satisfactory. Contracts for supply show an increase during the year of 11,307 h.p., and connections to mains an increase of 8,954 h.p.

The Bosch Co.

The report for 1919-20 of the Robert Bosch A.G., of Stuttgart, states that a considerable increase took place in the turnover, particularly through deliveries to other countries. Sales organisations were opened at Zurich and Prague; the sales office at Geneva suffered under the great difficulties of the automobile works in Switzerland; while the course of business at the sales office in Budapesth was very unsatisfactory. It had been possible to increase the number of workmen at Stuttgart and Feuerbach to 8,231, but at the end of the financial year the total had been reduced to 7,982, as restrictions in working had to be introduced in consequence of the increasing diminution in orders. Including the balance forward the accounts show net profits of 6,932,000 marks, as compared with 2,919,000 marks in 1918-19, and a dividend at the rate of 10 per cent. has been declared, as in the preceding year. The directors add that if the sale of the company's chief manufactures in other countries should meet with further difficulties preparations had been made for taking up the manufacture of other products.

The Italian Edison Co.—The Societa Generale Italiana Edison di Elettricite, of Milan, reports net profits of 10,315,000 lire for 1920, and a dividend of 36 lire on the 240,000 fully-paid shares and 13.13 lire on the 80,000 partly-paid shares. The share capital is being increased from 96,000,000 to 180,000,000 lire, and 10 per cent. of the augmentation is being allotted to the Compagnie Continentale Edison of Paris.

Tyneside Electrical Development Co.—The directors recommend a dividend at 6 per cent. per annum on the preferred ordinary shares, less tax, carrying forward £1,383. No dividend is to be paid on the deferred ordinary shares. No return has been received on the investment in the Tyne Electric Steel Foundries.

Metropolitan-Vickers Electrical Co., Ltd.—A notice appears in the *Financier* reminding preference shareholders that the option to convert their holdings into ordinary shares, at the rate of two ordinary shares of £1 for each preference share of £2, expires on April 14th next.

Bruce Peebles & Co., Ltd.—Shareholders who intend to accept the offer of two new shares for every nine held have to do so by April 30th. The issue is of 36,469 ordinary shares of £1 each at par.

Waste Heat & Gas Electrical Generating Stations, Ltd.—The report for the year ended January, 1921, shows that the profits, after deducting administration expenses, were £34,439, as against £39,626 in the previous year. £17,763 was brought forward. £14,000 is put to reserve. A dividend of 8 per cent. for the year requires £25,600, and £12,603 is to be carried forward. The amount standing to the credit of the reserve account is now £127,851. The redemption funds with respect to plant supplied on hire purchase terms amount to £18,505. Capital expenditure during the year was £25,939, mainly in connection with the new power station at Horden. The plant at this station was first operated in September last, but the full output has not yet been obtained due to non-delivery of certain parts of the plant and latterly due to reduced supplies of waste heat and gas. The delays in starting the new plant at both Horden and Weardale, together with higher costs, account for the reduction in profits. The aggregate output from all the generating stations has been maintained compared with the previous year. A further sum of £1,012 was expended during the year on experimental work.

Hadfields, Ltd.—After paying 5 per cent., free of tax, on the ordinary shares for 1920, £135,728 is to be carried forward. Operations were seriously affected by the moulders' strike, which caused reduction in profits earned and in reduction of the dividend. With the object of developing the use of the Hadfield system of manufacture and the sale of their special products in the U.S.A., the company have joined with the American Clay Machinery Co., of Bucyrus, in forming the Hadfield-Penfield Steel Co., in which Hadfields, Ltd., now hold a substantial interest. No immediate cash contribution from this company is necessary. The reconstruction of the company's war extensions to adapt them to post-war trade and the installation and equipment of the new steel foundry and rolling mills have involved a very large capital outlay to which has to be added the provision of additional working capital required to finance their output. An issue has been successfully made of one million pounds of 7½ per cent. debenture stock, redeemable in ten years.

Wycombe (Borough) Electric Light & Power Co., Ltd.—During the year 1920 the connections increased by 338 kW to 3,519 kW. Considerable repairs carried out and a new additional condenser installed. The new plant installed in 1919 has resulted in further generating economies. Cost of labour and fuel greatly increased. Including the balance from the contracting business there is a gross profit of £16,993, against £2,845 in the previous year. After paying debenture and loan interest, &c., and providing for income tax and adding the amount brought forward, £11,662 remains to be dealt with. A dividend of 7½ per cent. is to be paid, absorbing £3,750, £5,000 is to be put to reserve for renewals, and £2,500 to a general reserve fund, leaving £412 to be carried forward. The Electricity Commissioners increased the maximum price allowed to be charged as from July 1st, 1920, to 1s. per unit. The maximum authorised is not being charged.

Stewarts & Lloyds, Ltd.—According to the *Financial Times*, dividends are announced at the rate of 10 per cent. for the half-year on preferred ordinary shares, 2s. per share and bonus of 1s. per share on fully-paid deferred shares, 6d. per share and bonus of 3d. per share on deferred shares 10s. paid, and 1s. per share and bonus of 6d. per share on fully-paid deferred exchanged for shares in Alfred Hickman. Carried forward £114,356. Dividends on the preferred ordinary shares are less tax and on the deferred shares free of tax.

Browett Lindley & Co., Ltd.—Net profit for 1920, after deducting £2,399 debenture and bank interest, writing off £4,292 for depreciation upon buildings, machinery and patterns, and providing for income tax, was £8,694, plus £9,484 brought in, making £18,178. Directors propose further dividend of 6 per cent. on preference shares on account of arrears, of which 3 per cent. was paid September 30th, 1920, less tax; dividend of 8 per cent. on ordinary shares, of which 4 per cent. was paid on September 30th, less tax.—*Financial Times.*

Stock Exchange Notices.—The undermentioned have been ordered to be quoted officially:—

Globe Telegraph & Trust Co.—54,273 ordinary shares of £10 each, fully paid. Nos. 181,128 to 235,400.

Hastings & District Electric Tramways Co.—£104,450 4½ per cent. debenture stock.

Lanarkshire Tramways Co.—373,750 shares of £1 each, fully paid, Nos. 1 to 373,750.

Newmarket Electric Light Co., Ltd.—During 1920 3,241 (33-watt) lamps were connected to the mains, making the total 38,933. The gross profit was £2,953, against £2,351 for 1919. After providing for debenture interest £710, and adding £303 brought forward, a dividend of 3 per cent. is declared. £1,500 is carried to reserve for renewal of plant, and £249 is to be carried forward.

American Telephone & Telegraph Co.—A *Central News* dispatch from New York announces that the dividend is to be increased to 9 per cent., in order, under the new conditions resulting from the war, to make subscriptions to new stock issues attractive.

Mirrlees Watson Co., Ltd.—Dividend of 10 per cent. and bonus of 7½ per cent., both less tax. £25,000 to general reserve, carrying forward £14,409.

Vickers, Ltd.—The following final dividends for the half-year ended December, 1920, are announced: 2½ per cent. on preferred 5 per cent. stock (less income tax); 2½ per cent. on 5 per cent. preference shares (less income tax); 2½ per cent. on cumulative preference shares (free of income tax up to 6s. in the £). According to the financial Press, the books of the company for the year 1920 are practically complete as far as ordinary transactions are concerned, but there are still outstanding questions with Government departments of such importance that the directors regret it is not possible yet to present final accounts for the year, or even to state definitely when that will be done.

Torquay Tramways Co., Ltd.—Dividend 8 per cent. for the year 1920, free of tax. To reserve and renewals account £8,000; to reserve for equalisation of dividends £1,000. Carried forward subject to E.P.D. (1919 and 1920) and income tax, £10,302.

Belgium.—The report of the Société des Tramways Electriques de Gand, Ghent, for last year shows a profit of only 341,687 fr., as compared with 369,016 fr. in the preceding 12 months.

Metropolitan-Vickers Electrical Co., Ltd.—The directors have decided to recommend the payment of a dividend on the ordinary shares of 12½ per cent. for the year ended December, 1920.

Parker, Winder & Achurch, Ltd.—Total distribution on the ordinary shares for the year 10 per cent., less tax, carrying forward £4,207.

STOCKS AND SHARES.

Tuesday Evening.

The principal event in those Stock Exchange markets with which we deal is a substantial rise in Underground Electric Railway Income Bonds. The price has been rising steadily on balance for some weeks past, and just before the holidays it gained 5½ points with an advance to 71½. This came about as the result of expectations of extraordinary holiday traffics, with a consequent favourable result upon the dividend. Most of the rise has been retained, and the 1s. shares rose a trifle in sympathy. Other stocks in the railway market are also better, Metropolitans putting on 30s. at 24 and Districts 10s. at 14. So far as the steam stocks are concerned, the market is puzzled by the outlook in the coal trade. Amalgamation of the London and North-Western and the Lancashire and Yorkshire lines is a significant move on the part of two of the "Heavy" Home Railway companies, and prices are good in consequence.

Holiday influences are still at work in most of the Stock Exchange markets. Evidently tempted by the spring-like weather, the attendance at business both on the part of clients and their Stock Exchange agents has been noticeably affected by the Easter recess.

Electricity supply markets are indifferent to the prospect of a coal strike occurring. Several of the principal shares are better on the week. There are rises, for instance, in Charing Cross, County, Metropolitan, St. James's, and Westminster ordinaries and in Metropolitan preference. Following upon the improvements of the last two weeks, the advance is noteworthy, more particularly in view of the fact, already quoted here, that several of the companies are known to be on the point of issuing fresh capital. The City of London will probably be in the field first. A good deal of interest attaches to the Central Electric borrowing. A Metropolitan issue is said to be at hand. Some of the others may put off their appearance until it becomes clear whether the Bank Rate is to be lowered. Anticipation runs high that the 7 per cent. will give place to 6 per cent. this week.

Manufacturing shares are better. Metropolitan-Vickers ordinary have risen to 19s. 6d., and the preference are 5s. up at 1£. English Electric hardened to 11s. 6d., General Electrics to 23s. 9d. Babcock & Wilcox are unchanged by the coal outlook. British Aluminium retain their strength at 17s. 6d. There is noticeable demand for all the best class preferences, and the majority of these are in short supply. Edisons are quiet at 10s., and Henley's at 27s. 6d. The new Henley's are about 1s. lower.

Movements amongst foreign issues are somewhat mixed. Montreal Light, Heat and Power Common shares at 90 are 7½ points down, whereas Canadian General preferred rose to 105½. Improvements of 2½ points lifted Mississippi Power Common to 17, the preferred to 100. Mexicans are still rather on the dull side, and in Argentines there is not much going on.

Metropolitan Electric Tramways 5 per cent. debenture stock eased off to 56½. The market for prior-charge stocks in the Home Railway list, however, is better. City & South London 4 per cent. debenture has advanced to 54. There has been a little demand for East London Third Debenture, rallying the price to 12½. The ordinary, it may be mentioned, stands at 3.

In the cable group, Eastern Extensions and Western Telegraphs are both ½ higher at 16½. Globe ordinary improved to 15½ ex dividend. At the Exiles Club, where men of the Eastern group foregather when home on leave, the opinion is that arrears of work are steadily being overtaken, and that it should not take long, under to-day's conditions of working, for cabling to become normal as regards speed and reliability. The companies are scarcely recovered even yet from the effects of the war, but everything is being done to restore a satisfactory state of affairs to customers, staff and material alike. The competition of wireless continues to be a topic of lively debate, but the same opinion is held in Eastern Telegraph circles as in those of the Stock Exchange that plenty of room exists for both systems. Marconi's have risen to £2. The dividend time comes in June, and it may be recalled that the company paid only 1s. a share in December, as against 2s. in the previous corresponding period. Anticipation now runs that the dividend may be made up to 5s. for the year. Radio Common are better at 10s.; the preferred keep round about 11s. 6d.

The rubber market is singularly steady, having regard to the fact that there is so little improvement in the price of the raw material. Rubber shareholders take the philosophic view that the price of the produce has fallen so low that it cannot go much worse; consequently any change is almost sure to be for the better. In the armament market, Vickers are holding their improvement, and Armstrongs keep very steady at 18s. 3d. The recent excitement in Dunlops has given place to a more placid state of affairs. As stated above, there is not much business doing in Stock Exchange markets, but if the Bank Rate should go down on the Thursday in this week, this will prove an added stimulus to the present strength of gilt-edged stocks.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price March 22, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	£3	—	£20 12 0
Charing Cross Ordinary	7	8	82	+ ½	10 6 6
do. do. 4½ Pref.	4½	4½	98	—	8 8 8
Chelsea	4	6	83	—	9 10 6
City of London	13	14	25/-	—	11 4 0
do. do. 6 per cent. Pref.	6	6	18/-	—	6 13 4
County of London	8	8	78	+ ½	10 2 4
do. do. 6 per cent. Pref.	6	6	85	—	7 6 6
Kensington Ordinary	7	9	4½	+ ½	10 11 10
London Electric	2½	9½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	98	—	10 18 2
Metropolitan	6	7	8½	+ ½	10 15 4
do. 4½ per cent. Pref.	4½	4½	2[illegible]	+ ½	7 13 2
St. James' and Pall Mall	12	12	£3	—	10 0 0
South London	6	—	98	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	6½	+ ½	9 15 2
Telegraphs and Telephones.	1918	1919			
Anglo-Am. Tel. Pref.	6	6	87½	—	7 9 3
do. Def.	33/6	1½	18	—	9 7 6
Chile Telephone	6	6	84	—	7 6 8
Cuba Sub. Ord.	7	7	84	—	10 18 4
Eastern Extension	10	10	17½	+ ½	6 4 3
Eastern Tel. Ord.	8	10	160½	—	6 4 7
Globe Tel. and T. Ord.	8	10	15½	+ ½	6 7 8
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	90½	—	10 14 8
Indo-European	18	10	80	—	8 8 8
Marconi	25	25	2	+ 1/8	—
Oriental Telephone Ord.	10	12	9.3/4	—	6 5 9
United R. Plate Tel.	8	8	6½	—	6 10 8
West India and Panama	1/8	Nil	[illegible]	—	Nil
Western Telegraph	8	10	16½	+ ½	6 4 8
Home Rails.	1919	1920			
Central London Ord. Assented	4	4	65½	—	6 4 6
Metropolitan	1½	1½	24	+3	6 5 0
do. District	Nil	Nil	14	+½	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	8/8	—	Nil
do. do. Income	4	3	71½	+5½	9 16 0
Foreign Trams, &c.	1918	1919			
Anglo-Arg. Trams, First Pref.	Nil	84	98	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	84	—	Nil
do. do. 5 % Deb.	5	5	69½	—	8 8 8
Brazil Tractions	Nil	Nil	87	—	Nil
British Columbia Elec. Rly. Pfcs.	5	5	86	—	5 18 6
do. do. Preferred	24	5	54½	—	*8 14 0
do. do. Deferred	Nil	3	51½	—	*11 17 6
do. do. Deb.	44	44	84½xd	—	7 10 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	87	- 2	Nil
do. 6 per cent. Bonds	Nil	Nil	21½	—3	Nil
Mexican Light Common	Nil	Nil	19½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	59	- 2	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	21	—	*6 6 4
British Aluminium Ord.	10	10	17/6	—	11 8 6
British Insulated Ord.	12½	15	1½	—	10 0 0
Callenders	25	15	1.7/8	—	10 18 9
6% Pref.	6%	6%	17/6	—	7 8 7
Crompton Ord.	10	10	18.9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/6	+6d.	13 18 4
Do. Pref.	—	6	15/6	—	8 17 10
Gen. Elec. Pref.	6%	6%	18/6	+6d.	7 6 5
do. Ord.	10	10	1.5/8	+9d.	8 8 0
Henley	25	15	1£	—	10 18 2
do. 4% Pref.	4%	4%	8%	—	6 18 6
India-Rubber	10	10	2	—	—
Met.-Vickers Pref.	—	6%	1£	+ ½	8 10 8
Siemens Ord.	10	10	20/6	—	*9 16 9
Telegraph Con.	50	50	10%	—	*5 10 9

*[illegible] Dividends paid free of Income Tax.

THE LABOUR SITUATION AS IT AFFECTS THE ELECTRICITY SUPPLY INDUSTRY.

By T. W. COLE (Joint Secretary, Home Counties Industrial Council).

Industrial organisation is to-day one of the most important problems with which the electricity supply industry as a whole is faced. It is, in fact, not so much one problem as a series of problems, and, moreover, a series involving innumerable complex factors. Now, I suggest it might be useful to pass in review some of the chief elements of the situation. We shall certainly lose nothing by looking the facts squarely in the face.

We shall see best perhaps what we have to take into account by starting with the facts as they are at the moment. Let us take a bird's-eye view of the industry.

The industry consists of some 600 or so electric supply undertakings, covering between them the whole country, each undertaking separate and, broadly speaking, each without competition in its own area. The number of workpeople employed according to the Joint Industrial Council's figures is estimated at 29,000, and to this have to be added the technical and administrative staffs. Excepting a very small proportion, the whole of the foregoing are organised in some 20 or so trade unions. A proportion of the employés are highly skilled and absolutely indispensable. The majority are trained or have special knowledge, and only the residue are unskilled and readily replaceable. The whole (with the exception of the unskilled fringe, as it were) are permanently employed. It is an industry, indeed, where wholesale changes in workpeople are disadvantageous to the smooth running of any undertaking. Now, all this means that from the point of view of labour conditions the industry is in a very special position. Finally, no undertaking can afford to close down, one might say, even for a single hour, without serious public inconvenience. It can easily be seen that added together these factors constitute the elements of, at least, a preliminary problem. Then we have also to take into our view the Whitley system of industrial councils as at present at work in the industry, which introduces a profoundly modifying influence. Summarising the foregoing, we may say that there are three chief factors: the employers (covering the shareholders in the case of companies, and the ratepayers in the case of municipalities), the employés in the trade unions, and the Industrial Councils, and each of these factors is a variable. The problem for the industry as a whole is to effect an adjustment, and for this the utmost knowledge, foresight, and skill are required. Of these the most important at the moment certainly is knowledge, since nothing could be more disastrous than action based on a miscalculation of the constituent forces.

It is just these forces that I suggest it might be useful to bring under review, and which briefly are as follows:—

First, we have the trade unions' movement towards more and more effective organisation, and consequently increased power. This is, of course, a general movement affecting all trade unions alike in all industries.

Secondly, there is the rearrangement inside the trade union movement towards industrial unions instead of craft unions, and this has a special bearing on the electric supply industry.

Thirdly, there have to be taken into account various definite political movements which seek to realise themselves in and through industry, covering the whole range from State socialism to syndicalism.

Fourthly, there are the labour forces which impinge on the industry through the employers' side by way of municipal undertakings which are directed by labour municipal councils.

Fifthly, our consideration has to cover the directly shaping influences of legislation and Government direction dealing with labour, which tends to have on industry an effect which is little less than revolutionary as compared with the pre-war condition.

Finally, there is the interaction between the two sides of the Whitley Councils, the whole being itself modified by all the above influences.

Taking the foregoing *seriatim*, there is not much to say about the fuller organisation of the trade union movement so far as the workmen's unions are concerned, since this is already accomplished. For practical purposes we might consider that all workmen in the electric supply industry are now in one or another of the trade unions. There is no particular point to emphasise also with regard to the steady improvements which are taking place in the internal working of the separate trade unions which make them more coherent and an increasingly disciplined force. But when we come to the other section of employés, namely, the technical and clerical staff, we have a recent development which is most significant, and likely to play an increasingly important part in the future. There is now a fully-organised trade union covering practically the whole of the technical operating staffs of the important undertakings of the country. The clerical staffs are also organised in part, in other unions, although in a much more fragmentary and indefinite form; they do not, therefore, count as in any way an important factor industrially. The important fact is that the whole of the employés concerned in the effective working of the undertakings are in unions and, moreover, in unions which would admittedly act in concert. (The details of these separate unions and their relationships are somewhat complicated, and might perhaps be dealt with later on separately.) It is obvious from this that a return to pre-war conditions of industry is impossible, unless, indeed, the unions disintegrated of their own accord, which is not to be anticipated!

The second point mentioned, namely, the movement inside the trade unions towards industrial unionism instead of craft unionism, is a matter warranting the most serious study. An industrial union is one which is based on the inclusion of the whole of the personnel of a particular industry, so that all grades of workers engaged in the industry are associated in a single union. The craft union, on the other hand, in its simplest form covers only those of a particular trade, its members being dispersed in perhaps innumerable industries. There is a general tendency, however, for amalgamation of unions, and following this a possible reorganisation on an industrial basis. But coming more specifically to the case of the electric supply industry, there is one union, the Electrical Trades Union, which is confessedly ambitious to work out a programme of industrial unionism for the electric supply industry. The Electrical Trades Union is obviously the only union in the industry which could seemingly fulfil this rôle of an industrial union. The object, in the words of one of their own writers, is "the complete organisation of all employed in the electrical industry within the ranks of the E.T.U." An issue of the electrical workers' journal, the *Electron*, of February, contains an article on "Reorganisation," in which the writer deals with this proposal for complete organisation of all workmen employed in the industry, and with inducements which might be held out by the Electrical Trades Union so as to bring the whole of the workmen within the E.T.U. It is noteworthy that he includes supervisory grades up to charge engineers of power houses. If this is achieved the Electrical Trades Union will be, so far as the electric supply industry is concerned, practically an industrial union. The importance of such rearrangement of the unions lies mainly in its sociological aspect and its relationship with those revolutionary programmes which seek to work through industrial reor-

ganisation. The most recent phase of socialism, namely, guild socialism, can indeed be realised only through industrial unions, since so far as individual works are concerned, the programme of guild socialism is that each works shall be run by the workers. The combination of all the workers in an individual industry is an essential in guild socialism; in fact, speaking of the present craft unions' state of unionism, the author of "Guild Socialism Restated" shows clearly that craft unions are recalcitrant factors to deal with in smoothing the way towards guild socialism, and points out that the present trade union "in all the regulations which it lays down still always remains a body external to the actual conduct of industry."

The ambition of the Electrical Trades Union in striving to become an industrial union has thus a special sociological significance. Indeed, at a Conference in Blackpool in May, 1919, a resolution pointedly embodied the whole matter in the following terms: "To take over the control of the electrical industry in the interests of the workers." It is a point that should be noted in connection with industrial unions that the Electrical Power Engineers' Association falls in line, as far as its own stratum is concerned, with this movement towards industrial unionism. This was not designedly so, of course, but lies in the nature of the case, and probably was not even thought of originally. But none the less, as will be seen when we consider guild unionism, it adds a most definite bias to the labour organisation of the industry. The importance of this tendency towards industrial unionism in the industry as replacing present craft unionism cannot be overestimated. The exact significance politically, so to speak, will be seen under our next consideration of the various political movements seeking to realise themselves in and through industry.

(To be continued.)

THERMAL CHARACTERISTICS OF ELECTRIC OVENS AND HOT-PLATES.

Discussion at Leeds.

At a meeting of members of the North-Midland Centre of the Institution of Electrical Engineers, held at Leeds on February 22nd last, when Mr. C. J. Jewell, chairman, presided over a large attendance of members, Dr. E. Griffiths's and Mr. F. H. Schofield's joint paper on the above subject, which was abstracted in our issue of February 18th, was read and discussed.

Mr. W. B. Woodhouse was particularly interested in the remark about the weakness of air insulation, because he knew that it was a very common delusion that air was quite a good insulator. The tests, however, showed quite definitely the danger of the movement of air. He would emphasise that there was not much object in packing tight. If they could keep the air from circulating the less solid the insulating material used the better. One striking point that Dr. Griffiths had brought out was that when one used a radiation heater a black pot was a very good thing to employ, and there was no particular point in polishing it.

Mr. Allsopp thought the authors should have conducted their tests with water or other fluid, and in connection with the oven tests he strongly considered that those tests were of no value whatever for cooking purposes. The results were so similar that one was led to understand that one did not differ very much from the other, but there would have been vastly different results had those ovens been loaded up with materials that would represent as near as possible the actual process of cooking. They had to provide cooking temperature for cooking various objects of various sizes, and he did not think that the experiments or the tests so taken would be of much use as a guide. In connection with the hot plates, they were told in the early days that it was necessary, and that it was the right thing, to have a vessel with a very thin bottom, but he found that by using a cooking vessel with a large section of wall, such as an aluminium saucepan, a pint of water could be boiled quicker on the same hot plate with the same amount of energy. He well remembered experiences with an electric oven which had appealed to everyone because the elements were, to all intents and purposes, concealed; the oven was loaded on the bottom side, and the elements were entirely out of sight. The oven could also be washed, which was an advantage, but the oven would not cook. The trouble was that the dispositions of the loading and the elements were wrong. Those experiences explained how some manufacturers threw ovens out on to the users and trusted to luck for their being satisfactory. That was a point that ought to be watched carefully. He recalled another oven which had side heating. His wife objected strongly to changing a loaf round six or seven times during the process of baking; she did not have to do that with a coal or gas oven, and it should not be necessary with an electric oven. They did, however, get a successful oven built, *i.e.*, having the elements at an angle on each side; it had been in use for seven years, baking bread daily. The elements were placed well out of sight, and out of harm, and could not be damaged by liquids or fats. They did get circulation which could not be obtained in any form of radiant heater; as they were put on the market and designed at the present time, too much heat was thrown into the oven. There was only one successful radiant heat oven that would actually bake bread. If an oven would bake bread it would do anything that it might be called upon to do in the ordinary kitchen.

Mr. Hugh Gresley (Doncaster) was not quite clear why there was much higher efficiency when dealing with a thick disk as compared with a thin plate. Why was the closed type of hot plate used at all if the open type was so much more efficient? In ordinary kitchens, whether in private houses or hotels, the care necessary to keep the kitchen utensils with their thin bottoms in that perfect state which was essential would probably be missing, the pans would get knocked about, and the efficiency would become low. If they had electric cooking they must have hot water, but heaters as a rule, he believed, were very inefficient. With regard to ovens, there seemed to be great objection to the heaters being disposed along the side or along the bottom on the ground of cleanliness. He did not believe any oven would find much favour unless it was one that could be cleaned easily, and the best form of oven, if it could be made efficient, was one in which the heat was hidden away behind the wall so that the whole of the interior could be thoroughly cleaned out.

Mr. Jepson (Sheffield) remarked that in his house everything was done electrically, even washing, &c. They had an emergency heater in the boiler which was absolutely successful; it was a copper tank, and was in the house when he took it. There were three kW on the top, two on the next, and half a kW on the lowest heat. Instead of fixing it as he was advised officially by his firm to do, he fixed it in the centre, the reason being that one wanted a comparatively small quantity of water sufficient for washing up, or even for one bath. He had had it fixed in the centre so that it boiled the upper half first and the bottom remained cold, but if when the upper half was boiled the heater was switched on to the lowest heat and left on, conduction (which was very slow) would heat up the whole of the water. That was so successful that by switching on the top heat of 3 kW and leaving it on they could get three baths of water following one another, as much as one wanted in the house. In his house he had 108 amperes total capacity of heating apparatus; the maximum which he used was something like 60 amperes. It would be a tremendous problem to install mains to tackle the matter, but the potential load was there, and it was a useful load, and it was needed mostly after the works were shut down, and at week-ends. Strange as it might seem, people said it was extremely extravagant, but it was not; if one went out of the house one switched the current off; it was not like a coal fire. In Sheffield they were fortunately placed for low-priced energy, which was an attractive feature. He did, however, think that they, as electrical engineers, were to blame for not pushing electrical apparatus more; no doubt the first cost of apparatus was heavy, but it saved itself in the long run. His advice to the builders had been to put one chimney in the house, and a kitchen fireplace. In many places, particularly round the Sheffield area, many miners got their coal for nothing, so that it would be absurd to supply them with electricity when coal cost them nothing. Dr. Griffiths's paper was an extremely useful one, but unfortunately it did not go far enough, and it should be up to the Institution to recommend that the tests should be carried much further than they had been. He was rather surprised at some tests he had made on the "bulb fire," which had a parabolical reflector with a small heating coil. An aluminium kettle took about half an hour to boil the water, but when the bottom had been painted black, the water boiled in something like 16 minutes. Another important matter to bear in mind was that if they used the kettle a second time immediately after they had emptied it, the efficiency rose to 85 or 90 per cent. easily. That was because they were using the heat they had put into the bottom of the kettle. The loss by radiation was very small; that was an efficient way of boiling water when once they had got their vessel hot. It had often occurred to him that they might find some much quicker way of boiling water by some improvement in parabolical reflectors so as to focus the heat on to a small surface, so that they could throw the heat right on the vessel. A solid body was not the right thing to use in making a test. When they were using water in a vessel the bottom of the vessel heated the water, which was immediately carried upward by convection, and cool water took its place. The greater the gradient they could get between the vessel temperature

and the water the better and quicker the whole body would be heated up. In the case of a solid thing like a disk they did not get the cooling near the heater, they only got the effect of conduction. With regard to ovens, he had one in which the heaters were placed on the side and were circular in character. There were two circuits in each, an outer and an inner, and that oven worked admirably and was comparatively easy to clean. In cooking meat the best arrangement was to have a given radiating surface to strike on the meat, which closed the outer pores of the meat and kept the juices in. They had found this an easy matter with their electric oven in which there was a hook on which the meat placed inside was hung between two radiating plates; an even temperature was not so important. He agreed that the results obtained by the tests would have been far better if something had been placed inside the oven to absorb the heat which was given off; absorption in the oven affected matters seriously. It ought to be their first duty to try to develop electric heating, which unquestionably would become a thing of the future. It was only by installing it in their own homes and showing it to their friends that they could get people accustomed to it.

Mr. S. J. Jones (Batley) suggested that if Dr. Griffiths could get some ladies who were domestically inclined to go to his laboratory and talk things over with him, it would go a long way towards helping forward electric cooking. A gas oven could be used in a rough and ready manner, and until an electric cooker could be used in the same way he did not think they would meet with much success. Makers did not seem to know the necessary enterprise, and the first cost of electric cooking apparatus was so high.

Mr. Ingleby (Leeds), who spoke as a layman, suggested that the N.P.L. should take up the problem of producing a better heating element.

Mr. Wood (Bradford) described the Canadian house use of electricity. It was only a question of getting the apparatus in that country, because once the housewife got accustomed to an electric oven or iron she did not go back to the old style. English people when they first went out to Canada hesitated to use an electric iron, but they found out in the summer time that they were up against it, and one could see them going off to buy an electric iron. From one electrical appliance they quickly passed to others until their homes became fully electrically equipped.

Mr. Lovell (Leeds) emphasised the fact that they had to consider the practical point of view of the user, the housewife, and that very often seemed overlooked by the designer of apparatus at present on the market. The use of the word "efficiency" in the paper was unfortunate and open to misinterpretation.

Mr. Allsopp added that he felt certain that if it was left in the hands of a few salesmen to illustrate electric cooking to the housewife they would never get the electric cooker pushed forward. It must be done by the electricity supply undertakings; they must put their heart into the matter, and spend money upon its development. In Bradford at the present time they were seriously considering the further development of the electric iron. A scheme had been put forward to send out anything up to 1,000 irons on sale or return. Such a scheme had been developed in the States very successfully, and he thought that their Canadian friends owed a good deal of their development to working on the lines of sending the goods out on trial, and having faith that they would sell.

In replying to the discussion, Dr. Griffiths said he and his colleagues had found it extremely difficult to find anyone who had had actual experience of the matter. The word "efficiency," he agreed, was not a fair term to put into the paper, and it would be altered. He was very doubtful about using parabolic reflectors; it was surprising how difficult it was to concentrate heat on any object, a problem that needed solving. If he were using an enclosed plate he would go in for a thick bottom; they stood a better chance of retaining heat by this means than with a thin one.

Discussion at Birmingham.

On February 23rd the paper was discussed by the members of the South-Midland Centre of the Institution of Electrical Engineers.

Prof. W. Cramp, in opening the discussion, said that research of a scientific character upon electrical heating apparatus had for a long time been urgently needed. There were indeed few electrical matters about which so much nonsense had been talked as heating apparatus and its efficiency. The present paper attempted to deal with two aspects of the problem: One was the formulation of standard tests whereby apparatus could be compared and judged; the other was the efficiency of the apparatus. It was to be regretted that the word "efficiency" had been used in the paper to express the ratio of the heat absorbed by the proposed test block to the heat equivalent of the energy supplied to the plate, for that debited the plate with the heat energy emitted by the block. The results obtained had an interesting bearing upon similar apparatus heated by gas, for it would seem that gas rings constructed upon the radiant energy principle would be more efficient for boiling purposes than those of ordinary type.

Mr. N. B. Rosher welcomed the paper because he thought that if the use of electric cookers and heating apparatus was to become universal in the home there was much need for further research and practical experiment. One of the chief reasons, in his opinion, for the extensive use of gas cookers was the high cost of the electric cooker, which could be taken as about double the cost of a gas cooker of equal capacity. Another reason was that supply authorities had not followed the example of the gas authorities in providing cookers on the hire or hire-purchase system.

Mr. H. Joseph criticised the paper on the ground that the authors had departed radically from working conditions in their tests. He would like the authors to make it clearer why they had departed from the homely method of heating lagged vessels with specially prepared contact surfaces. With regard to oven experiments, the absence of working conditions appeared to leave room for further experiments. The thermometer was not an essential accessory; practice soon produced the requisite ability to judge the heat.

Mr. S. H. Holden mentioned that with some systems of domestic supply it was usual to fit a limit switch; that produced an objectionable intermittency of supply if the prearranged current was exceeded. Would that device be suitable as a safeguard for the supply authorities in the case of cooking apparatus, and what would be the effect of intermittency of current on the performance of a cooker?

THE NEW RAILWAY GOODS CLASSIFICATION.

The position with regard to the classification of goods carried on railways and the rates to be charged for them is beginning gradually to clear itself, as a result of the inquiry by the Rates Advisory Committee of the Ministry of Transport, although it will necessarily be a little while yet before a final conclusion is reached. It is a very intricate matter, and a solution can only be arrived at after the most careful consideration in which all parties concerned must endeavour with the greatest goodwill, to seek a just condition of affairs, both as regards classification and rates. It is not merely a question of carrying a certain weight of goods between two specified points. Many other considerations come into play, even to the extent of the effect of foreign competition. Any attempt to summarise the developments towards a more modern classification must be prefaced with the reminder that the existing railway goods classification was drawn up in 1888, and consists of classes A, B, and C, and numbers 1 to 5, but it must be recognised that much has happened since then which must of necessity modify the fundamental principles upon which the old classification was based. It was because of the prevarication to which the 1888 classification lent itself that traders welcomed the decision of the Ministry of Transport to hold a public inquiry prior to settling a new classification, not only because of the new circumstances after the war, but in the light of past irritating experience under the conditions as they existed before the war. Ample evidence of the latter is to be found in the number of complaints made annually to the Board of Trade and the proceedings before the Railway and Canal Commissioners concerning oppressive rates and treatment on the part of the railway companies. Treating all that as past history, however, we can come to the prolonged inquiry by the Rates Advisory Committee of the Ministry of Transport, the result of which, in a way, may be regarded by some people as disappointing, inasmuch as this committee did not itself attempt to devise a new classification on the strength of the views placed before it by the railway companies and traders, but merely laid down certain principles upon which it suggested the position in future should be governed; and at the same time it recommended the appointment of a new tribunal—to work simultaneously with the Railway and Canal Commissioners—whose function should be to fix the new classification of goods and fix rates, tolls, and charges, afterwards remaining in charge of this aspect of the situation, with power to vary and alter and generally to act as intermediary between the railway companies and traders. How far this new tribunal would overlap the work of the Railway and Canal Commissioners has yet definitely to be decided, but the intention appears to be that the new tribunal shall undertake the duty of fixing rates, tolls, and charges, and certain of the functions of the Railway and Canal Commissioners, leaving the latter to perform such duties as are not transferred to the new body. Questions of undue preference, for instance, and other questions of a legal character are presumably to be continued to be dealt with by the Railway and Canal Commissioners, although, speaking offhand, one would be inclined to suggest that it would have been better to have strengthened the Railway and Canal Commissioners and given them the additional duties suggested for a new tribunal, which, by the way, is to consist of three permanent paid members giving their whole time to the work, one being a person experienced in railway work, the second a person experienced in commercial affairs,

and the third, the chairman, a lawyer having no connection with railway or trading concerns, and not holding judicial office. In addition, there are to be two panels, one to be called the Traders' Panel, nominated by the Minister of Transport after taking the advice of the various traders' associations, and the other to be called the Railway Panel, to be nominated by the Minister of Transport after taking the advice of the Railway Companies' Association. This new tribunal, however, has not yet been constituted, but with a view to avoiding delay, the Rates Advisory Committee of the Ministry of Transport called upon the railway companies, during the public inquiry, to prepare a new classification to be used as a basis of discussion with the traders in arriving at the object desired by all, viz., greater simplification and clarity of definition.

The above may be regarded as a brief summary of the position at the close of the public inquiry, at which the Federation of British Industries necessarily took a prominent part as representing the engineering industry as a whole.

The railway companies duly submitted a new schedule. This, however, was not published until December 31st, 1920, and traders were given until January 31st, 1921, in which to lodge their objections and views upon it. Without in any way judging the success or otherwise of the railway companies in their endeavour to arrive at a greater simplification, it can be said that when the traders saw the really large volume which the new schedule filled, they were justified in complaining at being given only a month in which to examine it. Consequently, as the result of a universal protest by the traders' associations, the date of lodging objections was extended until February 28th, and the Federation of British Industries, which now has its own transport department, has placed a statement of the position before its affiliated bodies, and asked for recommendations to reach the Federation by February 14th. The general principles of the railway companies' proposals were considered at a public hearing before the Rates Advisory Committee on January 18th and 19th, and in order to avoid the putting forward of conflicting opinions within each industry, an endeavour is being made to form a co-ordinating committee composed of important representatives of the various large traders' organisations which are at present dealing with the matter. Meanwhile, the railway companies have agreed to publish the proposed classification in such a form as to show together the articles comprised in each class, and when this document is available the Traders' Committee of the Federation's transport department will be able to appreciate, and criticise if need be, far more expeditiously what is put forward.

From what has been said, it will be realised how impossible—or at any rate imperfect—would any attempt be to state in a comparatively few words what is the real position, as it now exists *qua* the details of the new classification. Nevertheless, the general result may be indicated, although there is little doubt that, as finally decided upon in the light of the traders' criticisms, there will be important changes in details. In reviewing this matter, emphasis should be laid upon the point that whereas in previous inquiries affecting the relations of the railway companies and traders, a considerable amount of antagonism has been shown between the parties, great goodwill is being shown, and both sides are doing their best to help the Rates Advisory Committee to come to correct conclusions. The railway companies have voluntarily made very substantial concessions to the traders, and their willingness to accept reasonable proposals of change deserves notice. The new classification shows an endeavour on the part of the railway companies to bring the same types of goods as far as possible into one class, with certain necessary subdivisions, and so successful have they been in this with regard to one class of engineering machinery—which does not happen to be electrical, however—that the particular trade association does not propose to exercise the right that it has of lodging formal objections, its views having been met to a considerable extent. The advantage of bringing goods into as small a compass as possible, as regards classification, must necessarily have the effect of producing considerable economies on the part of traders as regards clerical work, and eliminating the interminable arguments with the railway companies which have been so prominent in the past. So keenly is this recognised that it is felt the balance of advantage would be with the trader, even if the result of such a reclassification had the effect, as it will in some cases, of increasing the aggregate amount to be paid. There should be an end, for all time, to the absurd position that some machinery, by taking pieces off here and there, for example, can be sent under a totally different classification and a different rate. That is the object in view on the part of the traders, and we believe the railway companies fully appreciate that, the traders on their part recognising the difficulties involved. Instead of the Classes A, B, and C, and 1 to 5, it is now proposed to have 21 classes numbered 1 to 21, of which classes 2, 6, 10, 13, 16, 18, 19, and 20 are intended to cover articles hitherto carried at the class rates for old classes A, B, and C, and 1 to 5, and the other classes are intended to cover as far as possible, articles hitherto carried at exceptional rates below the appropriate class rates. There will probably be considerable discussion as to the minimum loads, because as the minimum loads have been raised from 4 tons to 6 tons to get the advantage of the lowest rate, it is clear that many traders will suffer considerably on this account, quite apart from the raising of the rates themselves, on the new principles laid down in the report of the Rates Advisory Committee. It behoves the various traders and their associations, therefore, to study the new proposals, first by comparison of the position under the existing classification and under the proposed classification, and secondly, the relative position of individual goods or similar products under the new classification. This, however, cannot be done efficiently until the railway companies publish the promised new volume setting out, side by side, the relative positions. For the moment, therefore, even traders themselves are not in the best position for giving helpful suggestions to their particular trade associations. The questions of owner's risk and exceptional rates will require most careful attention. In the opinion of some people, all goods in general should be conveyed at owner's risk, at the option and discretion of the owner to send them at the company's risk for an extra charge proportionate to the value of the goods, and the new classification, we believe, is on this basis. The question of exceptional rates, under the greater subdivision of the new classification, presents certain difficulties, but there seems every prospect of such difficulties being met and many of our past troubles being swept away under the soothing influence of the new tribunal.

Incidentally, it may be mentioned that in the Board of Trade *Journal* there has been published a list of increases in goods rates on the railway systems of the world since the war. We are not at all sure that any comparison of this kind is particularly useful, having regard to the varying conditions. Special interest does attach, however, for instance, to the general rebate in France of 10 per cent. on goods for export, and this method of assisting the foreign trade of Great Britain is one which might well receive sympathetic consideration, and so remove the anomaly of its costing more to send goods from the Midlands to the coast than it costs foreigners to send similar goods many times the distance over both land and sea.

OUR FUTURE TRADE WITH SPAIN.

(*Concluded from page* 375).

British Goods in Favour.

The lines in which preference for British goods is most pronounced include heavy machinery, steam generators, cranes, and pumps. There is much leeway to regain, as is patent from the results of the recent tenders for rolling stock for the Spanish railways. A further reduction in freight rates from the United Kingdom to Barcelona is essential.

In short, the outlook for British trade in Spain is undoubtedly bright, but a great deal depends upon the adaptability of the British manufacturer to the market, and, as stated before, a study of the methods of business which meet with success there.

Methods of Business.

It is exceedingly difficult for the average Anglo-Saxon to understand the Spaniard, and this is probably not fully realised by the British manufacturer. Only too often one hears of or meets with commercial travellers who are entirely ignorant of the language—in Spain, unlike South America, a good knowledge of the language is essential—and make no apparent effort really to understand the Spanish character. Consequently, although Spanish firms certainly have a marked preference for British goods and for trading with the British, on account of their reputation for straight dealing, orders go elsewhere.

Another point to remember is that although the Spanish merchant is a good payer, he likes credit, and will go where he can get it. As a general rule business should be done at 90 days from date of shipment. Spanish merchants prefer that bills should be drawn on them, and in dealing with respectable firms there is no difficulty in getting these bills discounted locally if it is desired. With the establishment of British banks and organisations such as the Federation of British Industries and the Commercial Secretary's Department, to say nothing of improved Consular representation, there should be no difficulty in taking up references in any doubtful cases, where credit is asked for.

The personal element is all important, and it should not be forgotten that certain forms of courtesy which are unusual in our country are traditional in Spain. Every Spaniard considers himself a gentleman—the differences between himself and others being merely accidental—and he expects to be treated as such.

To obtain the best results it is necessary to go to Spain and study the conditions and needs of the market, and it should be borne in mind that much business can be done outside the capital and other large provincial towns. Personal propaganda is, as has already been said, the best method of all, but much can be done with catalogues, circular letters, and advertisements, provided that: (1) They are written in correct Spanish—South American Spanish will not do for Spain; (2) the metric system is employed; (3) quotations are made c.i.f. Spanish port. How many British firms are prepared to do this? The Germans are doing all this and more, and there is no doubt that they will spare no effort to regain their hold on the Spanish market, aided, as they are, by a favourable rate of exchange. German travellers with ample supplies

of catalogues are to be found in villages where the British are never seen, and in districts where a command of the language is essential, they pay that minute attention to detail which goes so far to gain the sympathy of the Spanish merchant.

A last point, which is certainly important, is that of packing, which, in a country with rather irritating Customs restrictions, should not be overlooked.

Use of Electric Power.

All the principal towns in Spain are served with tramways, the large majority being electric. The business is still largely in the hands of the Belgians, although evidence is not wanting that the Spaniard is anxious to obtain control, as is shown by the recent absorption of the Madrid tramways by a Spanish company.

The importance of hydro-electric development in Spain is fully realised by Spanish engineers, and the hydro-electric power generated shows an increase from 281,000 h.p. in 1914 to 618,000 h.p. in 1920. According to fairly reliable sources, there are stated to be about 2,000,000 kW (1 kW = 1.34 h.p.) available, only taking into consideration waterfalls of more than 2,000 kW. This power is spread pretty well all over the country.

In view of the fuel problem, it is of paramount importance to Spain to avail herself to the full of all the electric energy that the country is capable of producing, but there are many difficulties to be faced in connection with it. Although this power is distributed practically all over the country, climatic conditions vary enormously, and, as a natural sequence, the flow of water in the rivers varies. Some rivers are dry in summer and fullest in the winter months, others, on the slopes of the Pyrenees, are dry in winter and fullest in the summer months, when the snows have melted. This irregular water supply makes some form of reservoir essential, and this has consequently been adopted by the majority of the companies which have put up large plants in that country. There are said to be 268 plants in the country, of which the following are the most important:—

	h.p.
S.A. Riegos y Fuerza del Ebro	130,000
Hidroeléctrica Española	64,000
Energia Eléctrica de Cataluña	60,000
S.A. Catalana de Gaz y Electricidad ...	41,000
Sociedad Productors de Fuerzas Motrices	20,000
Hidroeléctrica Ibérica	16,000

The enterprise of the Ebro Co. has certainly been of enormous benefit to Cataluña. Its power plants are on a scale previously unheard of in Spain. The transmission lines are upwards of 100 miles long, transmitting at 110,000 volts. On this plant hundreds of factories in the busy industrial centres of Barcelona, Tarrasa, and Sabadell, to quote only a few, depend, and it can certainly be stated that the difficulties of the coal situation, both during and after the war, have been very largely ameliorated by this one firm.

State Commission of Inquiry.

The importance of electric power in Spain has evidently not been overlooked by the State, as in 1918 a permanent Commission was appointed by Royal Order to consider the following points: (1) The possibility of the construction by the State of a national system for the distribution of electrical energy; (2) the maximum extension possible of such a system; (3) the approximate cost of such a system, calculated on a basis of normal prices or with copper at about £80 a ton; (4) the possibility of the State supplying the capital required or of guaranteeing its interest, taking tolls of the energy transmitted, or any other means of financing the system; (5) the possibility of a uniform system, and the means to secure it. The Commission published its findings in 1919, and it was estimated that the cost of the scheme would be about 130 million pesetas, but, beyond drawing up the main headings for presenting a Bill to the Cortes, the matter has not been proceeded with.

It is hoped that a final agreement will shortly be arrived at between the Spanish and Portuguese Governments for the utilisation of the falls of the Douro, from which power will be transmitted to Madrid and Bilbao for the electrification of the main line railways of western and northern Spain.

The hydro-electric enterprise is specially protected by the law of 1917 for the protection of Spanish industries, and it is scarcely an exaggeration to state that the future development of Spain is very closely linked with the progress made in the development of this great natural resource.

Lecture on Electric Vehicles.—An interesting lecture on electric vehicles was delivered on March 10th at the Salusbury Road sub-station by Mr. A. W. Blake, the electrical engineer to the Willesden Borough Council. The meeting was primarily intended for the garage attendants and drivers of the electricity department's fleet of electric vehicles, but was also attended by the other members of the staff. An invitation was also extended to the vehicle staffs of the Hammersmith and Hampstead undertakings, which was readily taken advantage of. The lecture was illustrated by lantern slides, and simplified diagrams of connections, and was followed by experimental demonstrations of first principles and of "short circuits," "open circuits," "earths," and simple series and parallel connections.

THE LONG-DISTANCE TELEPHONE SYSTEM OF THE UNITED KINGDOM.

By Sir WILLIAM NOBLE, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

This paper describes the development of the trunk telephone system since 1905, and deals mainly with the improvements in line plant design, especially in underground cable, which have been made during the past 10 years.

The expansion of the trunk-line system since 1905 led to congestion of the pole lines, and the difficulty of finding new routes increased. A scheme of direct cross-country routes of steel tower construction capable of carrying very large numbers of conductors was prepared, but at that juncture improvements in underground long-distance telephone cable led to a solution of the difficulty. Details are given of the valuable early work of P.O. engineers in devising methods and apparatus for balancing underground cable circuits so as to render them free from mutual interference and cross talk. This early work led up to the modern precision method of cable balancing which was first applied to a 52-mile cable laid between Leeds and Hull in 1913, which involved the making of over 90,000 capacity tests under field conditions, and every individual mile of the cable throughout the whole route was balanced to a very high degree of accuracy. The cable without any modification or adjustment was found suitable for working simultaneously, without cross-talk or disturbances of any kind, loaded physical telephone circuits, loaded superposed or phantom circuits, and high-speed Wheatstone automatic telegraph circuits.

The programme of construction for 1914 included the provision of a main cable-duct route from London to Liverpool via Birmingham, and the first cable on this route was completed as far as Birmingham in June, 1915, and extended to Liverpool in 1916, being designed to give 30 circuits between London and Liverpool, and 42 between London and Birmingham and Birmingham and Liverpool. The results obtained from this cable removed all doubts as to the future success of the underground trunk cable in relieving the congestion on the aerial lines, but the quality of service afforded by this cable in comparison with that previously given by aerial lines led to a rapid increase in traffic between the centres connected by the cable. Whereas a loss of 10 to 15 per cent. of working time was a common experience on long aerial lines, the loss on these cable circuits was nil.

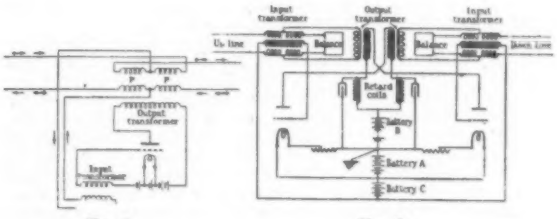


Fig. 1. Fig. 2.

Fig. 1.—Two-way Repeater with Single Amplifier.
Fig. 2.—Two-way Repeater with Up and Down Amplifiers.

More than once during the war the London-Liverpool cable saved the telephone trunk system from serious breakdown. This was notably the experience after the extraordinary blizzard which caused so much havoc in March, 1916. The storm swept across the country in a direction north-east to south-west, and reached a force of 75 miles an hour over a belt of nearly 100 miles in width between the Wash and the Bristol Channel, and was accompanied by a heavy fall of snow. Within little more than two hours practically every pole line inside that belt had been destroyed, and roads, railways and canals were blocked with the poles and wires thrown across them. It was an unparalleled disaster in the record of the telegraphic and telephonic services of this country.

Owing to the success of this premier cable, within two years of its completion every available circuit had been allocated, and the question of providing a second cable arose. It was evident that it would be necessary to increase considerably the capacity of underground duct routes in order to cope with the expansion of traffic which would follow on the extension of the underground system. At this juncture, however, the introduction of the three-electrode thermionic tube completely changed the aspect of the telephone repeater problem.

The "soft" valve has now been superseded by the "hard" valve for all telephone repeater work, but the thermionic valve with its associated input and output transformers has only a unilateral action as an amplifier. For use in the ordinary two-wire telephone circuit it must be duplexed in order to transmit and amplify speech currents in both directions through the circuit; this is effected on the principle of the duplex telegraph relay, by the use of differential winding on the line side of the output transformer (fig. 1).

Since the introduction of the thermionic valve amplifier the unbalance difficulty has become one of the chief difficulties in modern balanced repeaters. In practice, the use of the simple differential repeater circuit shown in fig. 1 is limited to those cases where the repeater can be inserted at the electrical centre of a homogeneous and stable line circuit. This condition is obtainable generally only in well-constructed cables. In this country it is seldom obtainable on aerial lines owing to the variations caused by our climatic conditions. Under

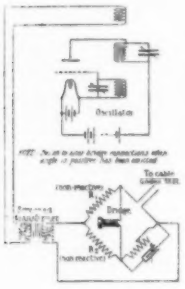


Fig. 3.

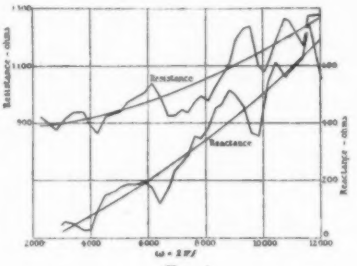


Fig. 4.

Fig. 3.—Bridge and Oscillator for Impedance Measurements.
Fig. 4.—Impedance/Frequency Curves for 70-lb. Cable Circuit.

the best conditions of a cable circuit the simple differential repeater may be operated to give a transmission improvement equivalent to the suppression of 16 miles of standard cable in a circuit having an equated length of 30 miles of standard cable. It has been found generally impracticable to use the simple differential repeater for tandem working.

This limitation led to the development of the double differential repeater shown in skeleton form in fig. 2. In this arrangement the line circuit is divided at the repeater station; each side is terminated in a duplex repeater and balanced by an artificial line designed to represent as nearly as possible the electrical characteristics of the actual line over the range of speech frequency. In practice, the balance can be made sufficiently accurate by the use of simple apparatus to permit the operation of as many as four repeater stations in tandem, each giving a transmission improvement equivalent to the suppression of 16 miles of standard cable. The minimum residual transmission equivalent of a repeatered circuit using repeaters of this type singly or in tandem is found in practice to be about 12 miles of standard cable.

It is necessary to measure the impedance of each line, if maximum efficiency is to be obtained from a repeater, to enable the balance to be calculated. The impedance characteristics of line circuits are obtained from a.c. bridge measurements made at frequencies ranging from 350 to 2,000 cycles per second. A thermionic valve arranged as an oscillation generator is used as a source of power for the bridge (fig. 3), and fig. 4 shows the results of measurements on a loop of 70-lb. conductors loaded with 135 mH coils at intervals of 2.6 miles. The mean curves for both the resistance and reactance components rise with frequency. This is due to the loading coil nearest to the office from which the measurements were made being too near to that office, and also to the effective

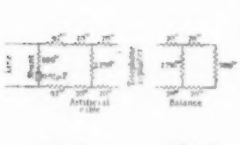


Fig. 5.

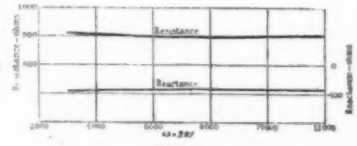


Fig. 6. Fig. 7.

Figs. 5 & 6.—Shunt and Artificial Cable Balance, Repeater on 70-lb. Loaded Cable.
Fig. 7.—Modified Mean Curves.

resistance of the loading increasing appreciably with frequency. The irregularities in the curves are due to various causes, such as unequal spacing of loading coils and variations between the inductances of the coils along the circuit. This cable was not designed for repeater working, and in more recent cables special care has been taken to keep the inductance of the loading coils within narrower limits and to maintain accurate spacing. An improved type of loading coil has been introduced by the Western Electric Co., which it is expected will be much less liable to vary in inductance with time, and the effective resistance of which varies much less with frequency.

One method of treating the cable of which the impedance curves have been illustrated is shown in fig. 5. A condenser in series with a resistance is placed as a shunt across the line, and this produces mean curves, fig. 7, which are practically horizontal. As the cable in this case is electrically short, an artificial cable is used to extend it, fig. 6, and the balance used is shown in the same figure. The necessity for extending the cable is due to the variations in impedance which result when a short line, that is, a line less than about 15 standard miles in length, is connected to lines or apparatus of differing impedances at the distant end. Such variations upset the balance of the repeater. If the line is sufficiently long, however, such connections do not sufficiently affect the balance to interfere with the working of the repeater.

The difficulties in operating circuits using differential repeaters in tandem have induced investigations of other systems for obtaining two-way facilities. The first is an adaptation of the principle of the simplex telegraph repeater arranged for up and down working. The line is divided at the repeater station, and the up and down sides respectively are led through the tongues and spacing contacts of an electromagnetic switch to the input circuit of an amplifier. The output circuit of each amplifier is cross-connected to the marking contacts of the opposite electromagnetic switch. The electromagnetic switches correspond to the automatic switches of the telegraph repeater, and are similarly controlled by the amplified outgoing currents, fig. 8. This principle has also been applied to wireless telephony.

The second system uses separate line circuits for transmitting in the up and down directions respectively. It is generally known as the four-wire system, fig. 9. The speech currents circulate in only one direction around the circuit and are relayed by the one-way amplifiers in each side.

In practice the terminal balances can be made sufficiently accurate to enable the repeaters to be operated so as to give a transmission improvement equal to the suppression of an attenuation length not less than that of the total line circuit. With modern balanced cables the repeaters may be spaced up to 30 standard miles apart; consequently very small conductors may be used. For long-distance cable circuits, beyond the economical range of the two-wire circuit with differential repeaters, the four-wire circuit offers important advantages and will be widely used.

Reference has been made to the London-Liverpool trunk cable and to the circumstances which led to its provision. Studies of traffic requirements between London and the Man-

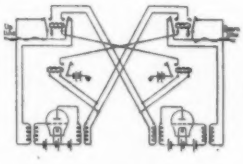


Fig. 8.

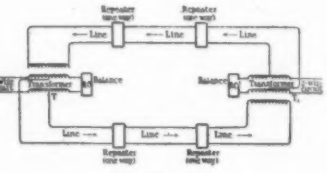


Fig. 9.

Fig. 8.—Repeater with Switching Relays.
Fig. 9.—Four-wire Repeater System.

chester and Leeds areas indicated the desirability of the same provision in these cases, and, but for the incidence of the war, a cable of similar capacity and efficiency to the London-Liverpool cable would have been commenced in 1914. Revision of the scheme in 1918 with later knowledge proceeded as follows:

The trunk circuits were required to give a transmission efficiency of 12 miles of standard cable between test-boards. This efficiency could be obtained with cable conductors weighing 200 lb. per mile of wire, loaded with 100 mH per mile, and a cable of maximum diameter would provide 42 circuits including phantoms. Such provision would barely suffice for two years' development, and a second cable would have to be commenced immediately on completion of the first. The development at the end of eight years would require several such cables, for which duct space should be provided at the outset.

Now assuming the installation of a midway repeater giving a transmission improvement of 14 miles of standard cable; then for an equivalent of 12 standard miles between terminal test-boards a cable containing 100-lb. conductors would be suitable. A cable of maximum diameter would provide 90 circuits including phantoms. The annual costs per circuit including repeaters would be approximately one-half that of the previous scheme, and the provision of a second cable would be postponed for about three years.

Further, assuming the installation of two intermediate repeaters each giving a transmission improvement of 14 standard miles; then the required efficiency between terminal test-boards could be obtained with cable conductors weighing 40 lb. per mile of wire, and the cable would provide 240 circuits including phantoms. The total annual charges per circuit would be approximately one-third those of the first scheme.

It was decided to proceed with the London-Manchester development on these lines, and at the time of writing this paper the duct route between the terminal stations has been completed and the cable is well on the way. Duct space has been provided to take care of developments for the next 20 years. The duct route forks at Derby, one route going north to Leeds and the other north-west to Manchester (fig. 10). The repeater stations will be located at Northampton and Derby, but a temporary repeater installation is being provided at Leicester, with sufficient equipment to operate the number

of circuits required for two years ahead. The circuits will be worked temporarily at a lower efficiency than that designed for the full scheme, but they will be equal to most of the existing aerial lines and will relieve the present congestion on the routes between London and Lancashire and Yorkshire. In addition to this, the risks of interruption of service by storms will be minimised.

At the present time the construction of similar main cable routes from London to Southampton and Portsmouth and from London to Bristol and the west has been commenced. In due course the northern cable route will be extended beyond Leeds through Newcastle and Edinburgh to Glasgow, so that in the course of a few years all main telephone communications between the important commercial centres of this country will be underground, giving a quality and stability of service which will be equal to, if not better than, any in the world.

With regard to submarine cable development, in 1911 Messrs. Siemens Bros. & Co. introduced a form of balata dielectric as a substitute for gutta-percha in loaded submarine cables, on account of the greatly reduced leakance of the former as compared with the latter. The effect of this improvement was to reduce materially the attenuation constant and increase the range of speech in loaded cables.

In 1914 the Post Office engineers obtained four circuits from a loaded four-wire submarine cable, with the circuits isolated

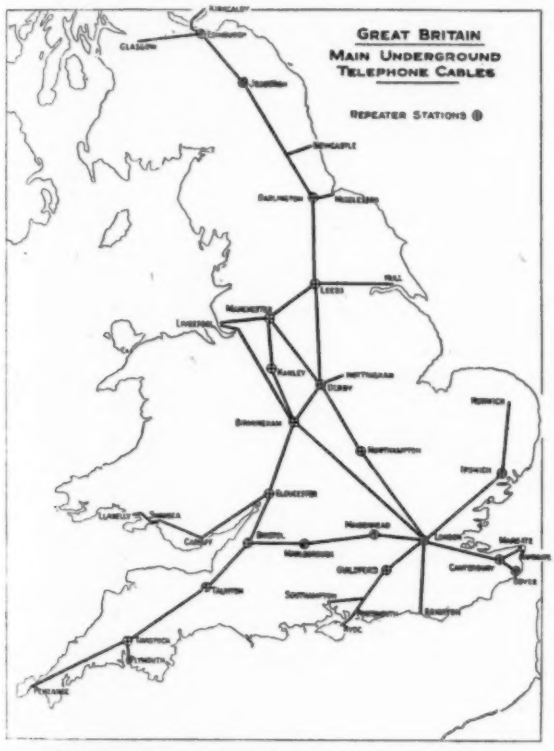


Fig. 10.—Main Underground Telephone Cables.

from the land lines at the ends of the cable by transformers, viz., the usual two side circuits and one loop phantom circuit, the fourth circuit being obtained by using the four wires of the cable in parallel with earth. Experiment shows that the fourth circuit can be made successful in a continuously-loaded cable, but it has not yet been successful in a coil-loaded cable.

In certain circumstances where a four-wire loaded cable could not be satisfactorily laid owing to the weight of the cable, it might be desirable to lay single-wire loaded cables, and an investigation of the electrical constants which might be expected in such a cable has been made by the Post Office. It is found that the effective resistance of the conductor in such a cable would be materially greater than that of half the resistance of a loop circuit of the same gauge, and experiment shows that, when tested at a frequency of 800 periods per second, the resistance is approximately 2.5 ohms more than that of the resistance of the same single wire when measured by d.c. The increase of resistance was found to be the same for conductors weighing 500 lb. per nautical mile per wire and 100 lb. per nautical mile per wire. The increased resistance in the two cases is due to the effect of the cable sheath and the return path consisting of sea water, and these are similar in the two cases.

To carry a large number of circuits across a wide river or estuary four-wire cables are unsuitable. To meet this requirement a continuously-loaded cable has recently been designed and is now being manufactured for the Post Office. This cable will contain seven quads, and it is hoped that seven phantom circuits will be obtained in addition to the 14 side circuits. The weight of the conductors is 70 lb. per nautical mile per wire, and of the dielectric 110 lb. per nautical mile per wire. The attenuation constant of the cable circuits for speech purposes is 0.05 per nautical mile, which is practically the same as that of the unloaded telephone submarine cable conductors weighing 160 lb. per nautical mile per wire and insulated by gutta-percha weighing 300 lb. per nautical mile per wire. This cable was the standard type for long-distance communication before the advent of loading, and it contained only four wires. This enables us to see at a glance the progress which has been made.

The introduction of telephone relays has made it possible frequently to use submarine cables of a less efficiency than the coil-loaded cables previously required. This makes it practicable to increase the use of continuously-loaded cables in which the difficulties of maintaining loading coils in submarine cables are entirely eliminated. The present policy is, on this account, to extend materially the use of submarine continuously-loaded cables.

Concerning high-frequency or so-called "wired wireless" telephony, it is becoming evident that developments of the system are destined to play an important part in the future in long-distance communication.

It may be said that the most attractive, and at the same time the most valuable, feature of the high-frequency carrier-wave system is its adaptability to multiplex telephony, that is to say, the simultaneous operation of several communication channels over one wire circuit.

The system is already in commercial service in Germany and in the United States on long aerial telephone circuits, but the conditions under which those services are possible are practically non-existent in this country. The economical value of the system for use in the United Kingdom lies in its application to underground cables. There are, however, a few cases where the system may be applied economically to aerial lines. Some of these are now being dealt with and will be brought into commercial service and linked up with the trunk system during the coming year.

CAPILLARITY AND SURFACE TENSION.

The growing importance of colloidal chemistry is leading to an increased interest in what used to be considered the somewhat academic subject of surface tension. This revival of interest should react usefully, for the colloidal state is in truth nothing but a fine state of division in which *surface action* becomes of paramount importance. Hence the importance of accurate measurements of surface tensions and the need for a systematic determination of capillary constants.

With this end in view the Faraday Society and the Manchester Literary and Philosophical Society arranged a joint meeting in Manchester on February 11th to discuss the present position of capillarity and surface tension measurements. The proceedings were opened by Sir Henry Miers, F.R.S., President of the Manchester Society, and the discussion was presided over by Prof. Alfred W. Porter, F.R.S., the recently-elected President of the Faraday Society. The discussion was led off by Dr. Allan Ferguson, who gave a very valuable and interesting critical survey of the methods that have been proposed and used for the measurement of interfacial tensions, whether between liquid-gas, solid-liquid, or solid-gas surfaces. The importance of analysing the different methods is obvious when it is realised how varied are the values of surface tension obtained depending on the experimental method employed.

The conclusion arrived at was that the most promising methods for systematic use were those depending on :—

(1) The measurement of large bubbles or drops;

(2) The measurement of the maximum pressure required to release a bubble of air from the end of a capillary tube immersed in the liquid;

(3) The measurement of the maximum pull on an anchor ring which is immersed in the liquid and slowly withdrawn therefrom.

In a second paper Dr. Ferguson and Mr. P. E. Dowson described a modification of the capillary tube method for the measurement of surface tensions, a method described as holding the affections of experimenters by reason of a somewhat delusive simplicity. The modification devised is to force down the meniscus to the end of a short capillary immersed vertically in the liquid and measure the pressure required to do so. This pressure is measured on a separate manometer, and the difference of level of the surfaces of the liquid in the gauge—magnified by using a light liquid—is a measure of the rise that would have taken place in the capillary. Temperature control is simple, and temperature measurements are made by means of a thermo-couple.

The great advantage of this method is that it dispenses with the tedious process of selecting a long capillary of perfectly uniform cross-section, and also does away with the necessity for calibrating and keeping clear such a capillary. Sources of error, such as the big temperature correction necessitated in measuring the rise of liquid in a capillary and the difficult measurement of the height itself, are also eliminated.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

7,728. "Electrical polarity indicator." R. D. Young. March 11th.
7,743. "Method of fastening electric cables and wires to porcelain, &c., insulators." W. R. Millar. March 11th.
7,744. "Automatic switches." W. J. Allen and W. D. Vick. March 11th.
7,749. "Supports for overhead trolley wires." E. R. Myers. March 11th.
7,753. "Insulating tape." W. Connolly. March 11th.
7,778. "Electric current regulators." W. Langdon-Davies and A. Soames. March 11th.
7,781. "Accumulators." W. T. Coulson. March 11th.
7,787. "Rectangular casing for electrical apparatus." Landis & Gyr Akt.-Ges. March 11th. (Switzerland, March 13th, 1920.)
7,795. "Electro magnetic apparatus for detecting electric currents." H. J. Dale. March 11th.
7,814. "Wireless receiving systems." Ges für Drahtlose Telegraphie. March 11th. (Germany, March 13th, 1920.)
7,817. "Induction regulator for mono and polyphase current circuits." J. Kristen and Maschinenfabrik Oerlikon. March 11th. (Switzerland, March 23rd, 1920.)
7,819. "Providing electric cables with distinguishable wrappings for various leads." Deutsche Kabelindustrie Ges. and H. Sefton-Jones (Deutsche Kabelindustrie Ges.). March 11th.
7,848. "Apparatus for detection of Hertzian waves." M. Marshall. March 12th.
7,882. "Cooling arrangements for electrical machines." A. Arutünoff. March 12th.
7,884. "Electro mechanically controlled telephone system." F. Aldendorff and H. Baron (Aldendorff). March 12th.
7,885. "Electric measuring instruments." F. Holden. March 12th.
7,887. "Oscillating valve relays." G. A. Mathieu. March 12th.
7,889. "Means for supporting thermionic valves." A. R. Taylor. March 12th.
7,896. "Electroplating apparatus." T. R. Canning and W. Canning & Co., Ltd. March 12th.
7,900. "Electric bells, &c." E. Magerle and J. Steiner Ges. March 12th. (Austria, March 12th, 1920.)
7,922. "Mine-signalling visual indicator." R. S. Gardner. March 14th.
7,933. "Electric motors." Automatic Telephone Manufacturing Co., Ltd. and A. E. Hudd. March 14th.
7,947. "Electric fuse-boards." J. B. Tucker. March 14th.
7,954. "Automatic, &c., telephone systems." W. Aitken. March 14th.
7,964. "Portable electric lamps." J. M. Fenton and Doherty Motor Components, Ltd. March 14th.
7,973. "Electrolytic cell." Elektrizitats Akt.-Ges. vorm Schuckert & Co. March 14th. (Germany, June 14th, 1920.)
7,982. "Means for magnifying effects of small efforts for telegraphy, &c." A. Orling. March 14th.
7,987. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 14th. (United States, March 29th, 1920.)
7,993. "Switch plates, finger-plates, &c." T. A. Ingram and J. M. Kaye. March 14th.
7,998. "Electric heaters." G. Durando. March 14th.
8,002. "Multiple low-frequency telegraphy." N. Koomans. March 14th.
8,009. "Ignition devices for internal-combustion engines." British Thomson-Houston Co., Ltd., and A. P. Young. March 14th.
8,011. "Guiding means for push-buttons in telephone boards." Telephone Manufacturing Co. (1920), Ltd. March 14th.
8,021. "Telephone systems with high-frequency oscillations." H. A. Gill (Deutsche Telephonwerke Ges.). March 14th.
8,031. "Electric signalling or call apparatus." C. F. Metcalf. March 15th.
8,047. "Dry storage batteries." W. Gardiner. March 15th.
8,049. "Electric starting and energy generating machine for automobiles." R. Bosch Akt.-Ges. March 15th. (Germany, November 29th, 1920.)
8,050. "Electro-mechanical lock." G. C. Ashbee. March 15th.
8,077. "Insulators for supporting electric conductors." E. Parry. March 15th.
8,079. "High-tension distributors for electric ignition apparatus." A. P. McGowran, M.L. Magneto Syndicate, Ltd. March 15th.
8,081. "Automatic braking apparatus for electric motors." McKenzie, Holland & Westinghouse Power Signal Co., Ltd. March 15th. (France, November 9th, 1920.)
8,089. "Electro-magnetic switch." F. Krupp Akt.-Ges. March 15th. (Germany, December 20th, 1920.)
8,096. "Apparatus for production of X-rays." E. E. Greville and F. W. Read. March 15th.
8,103. "Magneto-electric machines." H. W. H. Warren, British Thomson-Houston Co., Ltd., and A. P. Young. March 15th.
8,126. "Electric water-heaters." A. S. Dorsey. March 15th.
8,127. "Contact-breakers for magnetos." Duten, Doublet et Cie. March 15th. (France, March 19th, 1920.)
8,140. "High-frequency multiplex transmission." H. A. Gill (Deutsche Telephonwerke Ges.). March 15th.
8,141. "Circuit arrangements for multiplex cable telegraphy and telephony." H. A. Gill (Deutsche Telephonwerke Ges.). March 15th.
8,155. "Combined electric cooker and insulating box." W. M. Edwards. March 16th.
8,182. "Perpetual motion or magnetically-propelled power generator." A. E. W. Maseyk. March 16th.
8,187. "Electric torches, &c." P. V. Rowlands and W. G. Bean. March 16th.
8,197. "Electric starting gear for internal-combustion engines." W. B. Bond, Cheetham Motor and Engineering Co. and F. Sweeney. March 16th.
8,233. "Electric cables for conveyance of high-tension electrical energy." L. N. Reddie (Soc. Pirelli & Co.). March 16th.
8,235. "Commutators for dynamo-electric machines." G. Schroeder. March 16th.
8,247. "Frequency multipliers for alternating electric currents." P. Trichard. March 16th. (France, March 16th, 1920.)
8,256. "Electric primary cells." L. Darimont. March 16th.
8,277. "Reception of continuous-wave signals." H. J. Round. March 16th.
8,307. "Sparking plugs." R. S. Gallop. March 16th.
8,349. "Gearing for starting motors and electrical generators used on internal-combustion engines." F. R. Smith and Armstrong Siddeley Motors, Ltd. March 17th.
8,357. "Holders for telephones." C. H. Smith. March 17th.
8,370. "Sparking plugs." P. Challis. March 17th.
8,375. "Apparatus for suppressing higher harmonics in metal-vapour rectifiers fed through polyphase choking coils." Akt.-Ges. Brown, Boveri et Cie. March 17th. (Switzerland, March 27th, 1920.)
8,384. "Means for fixing electric cables and wires." Edison Swan Electric Co., Ltd., and F. C. Raphael. March 17th
8,399. "Electric rheostats." British-Thomson Co., Ltd. (Soc. d'Electricité et de Mécanique). March 17th.
8,412. "Thermo-electronic relays, &c." W. J. Mellersh-Jackson (Compagnie Générale d'Electricité) and W. J. Mellersh-Jackson. March 16th.
8,434. "Means for generating electrical power." R. B. Sparrow. March 8th.
8,448. "Electric heating apparatus." E. Muntwyler. March 18th.
8,462. "Electro-magnetic relays." W. E. Barber. March 18th.
8,467. "Constant speed dynamo drive." H. C. C. Thurgood. March 18th.
8,473. "Electric generating sets." A. A. Lyon. March 18th.
8,498. "Lamp-making machines." British Thomson-Houston Co., Ltd. (General Electric Co.). March 18th.
8,509. "Electric heaters for liquids." F. Nottet. March 18th.
8,510. "Means for facilitating identification of electric conductors." N. J. Austin. March 18th.
8,550. "Means for reducing starting load on hydraulic pumps, &c., directly coupled to electric motors." F. Simpkin and G. W. Whitelock. March 19th.
8,556. "Anti-dazzle device for electric head lamps." M. Kemp and W. H. Kemp. March 19th.
8,577. "Electric switches." H. Bufton, C. Marples and W. Marples. March 19th.
8,596. "Wireless receiving apparatus." W. W. Burnham and C. F. Phillips. March 19th.
8,606. "Electro-mechanically controlled telephone system." H. Baron (Aldendorff). March 19th.
8,630. "Directional wireless apparatus." C. K. Chandler. March 19th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,500. "Devices for locking incandescent lamps in their holders." G. F. Coulson. June 26th, 1918. (159,228.)

1919.

2,967. "Electric fixture support couplers." S. Percival (G. Lacey). February 6th, 1919. (159,229.)
19,225. "Electric conductors." St. Helens Cable and Rubber Co., Ltd., and S. H. Lee. August 5th, 1919. (159,233.)
28,260. "Means for controlling the operative field of magnets." L. W. Goold (National Safety Appliance Co.). November 14th, 1919. (159,260.)
28,609. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). November 18th, 1919. (159,267.)
28,788. "Ventilation and cooling of electrical or other machines." J. Smillie and Metropolitan-Vickers Electrical Co., Ltd. November 20th, 1919. (159,282.)
28,893. "Controllers for electric motors." C. E. Fairburn. November 20th, 1919. (159,288.)
29,094. "Method of preparing storage batteries for shipment or storage." U.S. Light and Heat Corporation. September 8th, 1917. (135,517.)
29,186. "Method of controlling electric motors operating fluid-pressure pumps or the like." H. P. H. Anderson. November 24th, 1919. (159,306.)
29,284. "Electro-magnetic switches." A. M. Jane. March 29th, 1916. (135,843.)
29,322. "Telegraphy." E. S. Heurtley and Muirhead & Co., Ltd. November 25th, 1919. (159,316.)
29,339. "Electric ignition collecting, distributing and timing devices and systems." G. M. Turner. November 25th, 1919. (159,317.)
29,392. "Electric thermionic amplifiers." British Thomson-Houston Co., Ltd. (General Electric Co.). November 25th, 1919. (159,322.)
29,977. "Electric switches." Adt Akt.-Ges., Geb. June 13th, 1919. (144,993.)
30,358. "Dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and J. C. Wilson. December 4th, 1919. (159,343.)
30,480. "Electric converting apparatus." W. E. Highfield and J. E. Calverley. December 5th, 1919. (159,345.)
30,584. "Mouth-pieces of telephones and the like." J. Jofeh. December 6th, 1919. (159,348.)
30,868. "Electrical static machines and apparatus for electro-therapeutic work and for like purposes." T. Clark. December 9th, 1919. (159,358.)
31,112. "Thermostats." Calico Printers' Associations, Ld., and G. Turner. December 12th, 1919. (159,365.)
31,561. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 16th, 1919. (159,374.)
31,673. "Wireless reception apparatus." J. Robinson and H. L. Crowther. December 17th, 1919. (159,377.)
31,806. "Refillable electric fuses." Perfect Refillable Fuse, Inc. December 18th, 1919. (136,840.)

1920.

1,768. "Electrically-propelled vehicle." J. H. Hansen. January 20th, 1920. (159,395.)
4,570. "Magnetic deflectors for electric arcs in lamps, searchlights, and the like." H. C. Gibson and J. P. Yorke. February 14th, 1920. (159,408.)
6,195. "Sparking plugs." E. Pethoud. October 6th, 1919. (152,623.)
7,944. "Compositions for insulating and protecting electrical apparatus and for other purposes." British Thomson-Houston Co., Ltd. (General Electric Co.). March 17th, 1920. (159,421.)
9,103. "Device for variably tilting the shades of electric lamps." H. H. Berry and W. J. Markham. March 29th, 1920. (159,424.)
9,178. "Sparking plugs and ignition-timing devices for internal-combustion engines." I. L. Slawter and W. Innes. March 30th, 1920. (159,425.)
11,493. "Portable electrically-driven vacuum cleaners." G. A. Celli. April 24th, 1919. (142,463.)
12,474. "Electrical time-keeping mechanism." C. D. J. Jamin. May 5th, 1920. (159,436.)
15,572. "Overhead trolleys or collectors for electric tramway and railway vehicles." T. Blaney and D. Williams. June 9th, 1920. (159,445.)
18,976. "Field magnets for magneto-electric machines." C. Von Der Weid. June 12th, 1920. (159,448.)
22,077. "Voltage regulators for electric current generators." Scincilla (Firm of). August 8th, 1919 (149,611.)
31,517. "Electrical speed-regulator systems." Metropolitan-Vickers Electrical Co., Ltd. November 6th, 1919. (153,582.)
34,897. "Thermostatic protective apparatus for use with bearings or other parts of a machine." Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (155,214.)

Electrical Treatment of Seed Wheat.—Experiments are to be undertaken at Werribee (Vic.) with an electrochemical process of treating seed wheat. It is claimed that considerably increased returns can be obtained by treating the seed electrically. The cost of treating is 1s. per bushel of seed, and the resulting increase in the yield is said to be from 25 to 30 per cent. Thus on 600 acres, with seed at 9s. a bushel untreated, and 10s. a bushel treated, and with a yield of four bags to the acre from ordinary seed, and five bags to the acre from electrically-treated seed, the respective returns in cash would be £2,970 and £3,750, representing a balance in favour of the treating process of £780. This means a very solid gain.—*Industrial Australian and Mining Standard.*